THURSDAY, NOVEMBER 26, 1914.

THE RESPIRATORY FUNCTION OF THE BLOOD.

The Respiratory Function of the Blood. By Joseph Barcroft, F.R.S. Pp. x + 320. Cambridge University Press, 1914.) Price 18*s*. net.

THE title of this book gives but an inadequate idea of the scope of its contents. As the author states in the Preface, it is really an account of his "physiological ventures," and consists mainly of the researches undertaken by himself and his pupils, with slighter references to cognate work by other observers. The wealth of new facts and ideas which are here presented bears striking witness to the important part played in the advance of science by the discovery of a new technique. In practically all the investigations here presented it was necessary to determine the gaseous contents of minute quantities of blood or other fluids, so that the discoveries here made may be said to be the direct outcome of Haldane's invention of a method for the gaseous analysis of small quantities of blood—a method since perfected and elaborated to such an extent by the author of this book as to be identified with him. Armed with this new technique, he was able to attack a number of capital problems connected with the behaviour of oxygen in the blood, its uptake in the lungs, and the conditions of its utilisation by the tissues, with an ease and accuracy which previously was impossible.

This book, however, is not a mere reprint of Barcroft's physiological papers. In presenting his results, he wisely abandons the chronological for a logical order. In the first part he begins with a description of the physical and chemical characters of hæmoglobin and the determination of its combining power for oxygen in relation to its iron content. The constancy of the figures obtained in his latest experiments for oxygen capacity and iron content is regarded by the author as almost convincing proof that the combination is chemical in the strict sense of the term. He then discusses the oxidation curve of oxyhæmoglobin and the influence of temperature, electrolytes and acids on the curve. An important result arrived at is that the variations which have been described in the dissociation-curves in the blood of different animals may be ascribed to differences in the salt-content of the blood-corpuscles, which determine varying degrees of the aggregation of the colloidal hæmoglobin molecule.

In part ii. he proceeds to discuss what significance these facts have for the normal life of the animal. The question of the factors which determine the supply of oxygen to the tissues during rest and activity, involves difficult physiological experimentation on the exchange of gases between tissues and blood in voluntary muscle, heart, adrenals, pancreas, kidney and liver. From these results we are led on to another series in which the oxygen intake of the tissues is used as a criterion of the activity of the tissue-cells. In this way he is able to throw a welcome light on the nature of some of the phases of renal activity —activity of the cells being assumed as responsible for urinary formation when an increased flow of urine is associated with an increased uptake of oxygen by the kidney. A chapter on the metabolism of the blood itself (which, except in abnormal circumstances, is shown to be negligible) is followed by an account of the mechanism by means of which the supply of oxygen to the tissues may be regulated according to their needs. Prominent among these mechanisms is the local production of lactic acid and possibly other metabolites, which not only have a vaso-dilator action, so increasing the blood-flow through the part, but also, by their action on the dissociation-curve of hæmoglobin, favour the transfer of oxygen from oxyhæmoglobin to the tissues.

In the next chapter he describes a bold attempt made by him in conjunction with Verzar to determine the head of pressure driving oxygen from the blood to the tissues, using as his criterion the effect of variations in the oxygen-supply on the amount of this gas taken up by the tissues.

Under normal conditions, the blood has only a certain time to take up oxygen in the lungs and to give up oxygen in the tissues, viz. the duration of its transit through the capillaries of lungs and tissues respectively. An investigation of the rates of combination and dissociation of oxygen and hæmoglobin enables the author to show that the physical conditions which determine the form of the dissociation-curve outside the body are sufficient to account for the changes taking place within the body. This investigation naturally leads on to a discussion on the much debated question as to the mechanism of the uptake of oxygen in the lungs. A very impartial account is given of the views and investigations of Bohr, Haldane, Krogh, and Hartridge. His final conclusion is in favour of the view according to which the process is determined by the physical conditions existing in the lungs, though he points out that the question cannot be regarded as finally settled until the results obtained by Haldane and others on Pike's Peak have been reinvestigated by Hartridge's methods or have received some adequate explanation.

The third part of the work deals with the dis-

sociation-curve of the hæmoglobin as an indicator of the reaction of the blood, and contains a wealth of interesting observations on the effects of diet, exercise, residence at high altitudes, and finally, certain pathological conditions associated with acidosis. The author is to be congratulated on the production of a book interesting not to physiologists only. The lively personal note of the narrative is a happy novelty in a physiological monograph, and will enable those of his readers who have not worked with him to appreciate and, in a measure, to partake of the genial optimism of the author. E. H. S.

GYROSCOPIC MOTION.

An Elementary Treatment of the Theory of Spinning Tops and Gyroscopic Motion. Second edition. By H. Crabtree. Pp. xv + 193. (London: Longmans, Green and Co., 1914.) Price 7*s.* 6*d.* net.

IN this, the second edition of Crabtree's admirable book, the text and paging of the first edition have been followed, but additions have been made where necessary, so that more recent developments may be dealt with. The first edition was noticed in NATURE (August 12, 1909, p. 182), so that it is not necessary to do more now than refer to the additional matter. The two monorail systems of Brennan and Schilowsky are illustrated and described. It may be mentioned that each of these derive their stability from a gyrostatic system, the action of which is independent of the forward motion of the car, so that the stability exists whether the car is moving forwards or backwards or is at rest, and in this respect differs entirely from the systems more recently invented by Dr. Gray.

There is a full discussion of the Anschütz gyro compass, but this is the same as that which is given in the manual published by Messrs. Elliot Bros., having been translated for them by the author and his colleagues. The writer of this notice hoped to have found also a description of the Sperry gyro compass, which differs in certain respects very materially from its forerunner, the Anschütz. A discussion by the author of the relative merits of the two systems where they differ would have been very illuminating. Unfortunately, this instrument is not mentioned. Other matters ably dealt with in the appendices are the swerving of golf-balls and the drifting of rifled projectiles, both subjects on which amazing nonsense is often written.

There is a statement in the earlier part of the book on the skidding of motor-bicycles, with which the present writer does not agree. Seeing that the back tyre is being constantly impelled to slip longitudinally on the ground by successive explosions in the cylinder, more especially where a rigid chain drive is employed, or where the flywheel of the engine is insufficient, and that a longitudinal slip will start a side slip, there is abundant cause for the side-slipping capacity of these machines, without looking to more subtle causes. Briefly, the author explains that in consequence of the gyrostatic action of the flywheel a transverse couple must be applied in order to make the flywheel's plane of rotation change when the machine is describing a curve. In order to apply this, the rider and machine must lean over to a very small extent more than would be necessary otherwise. So far so good; the transverse couple is caused by the weight of the whole combination of machine and rider acting vertically downwards, and a corresponding reaction at the road acting vertically upwards, and the arm of the couple is the excess of the horizontal distance between the centre of gravity and the wheel base due to the extra leaning. The transverse force on the road, which alone gives rise to side slip, is unchanged.

It is satisfactory to find that there is a sufficient demand for a book of such thoroughness as this to have called for a second edition in a comparatively short time. C. V. Boys.

BRITISH FLOWERING PLANTS.

British Flowering Plants. Illustrated by Three Hundred Full-page Plates, reproduced from Drawings by Mrs. Henry Perrin. With Detailed Descriptive Notes and an Introduction by Prof. G. S. Boulger. Vol. i. Pp. xlv + plates. (London: Bernard Quaritch, 1914.)

MRS. PERRIN'S book, of which the first volume is before us, is essentially a book for the use of ladies and those who take a dilettante interest in botany and flowers. It is unfortunate, therefore, that it is of such a weight that its presumed readers may scarcely have the strength or energy to handle the bulky tomes.

Not only are the plates heavily loaded with plaster of Paris, but the large quarto pages of text are of almost equal solidity. If the contents of the book were of any scientific interest or formed a real addition to knowledge, the great bulk of the volume would be a matter of sincere regret; we cannot, however, foresee any particular use for the book, except that its handsome back may adorn the shelves of an expensive library, and can only deplore that the money expended on this production could not have been put to some object of definite botanical value.

The paintings, which afford the *raison d'être* of the book, are on the whole good, though in

many cases a more artistic arrangement of the material might have been achieved. Some pictures, as that of the snowdrop, for instance, are unworthy of the book. To the botanist the pictures are of little value, owing to the absence of an analysis of the parts of the flower and fruit, and this defect is especially noticeable in the case of the plates of the bulrush and Luzula, which give no indication of the structure of the flowers. It may be urged that such details are relegated to special plates, but even then they are so poorly executed and often on so small a scale as to be of little assistance. It is unfortunate that the artist, who undoubtedly possesses considerable skill and has bestowed so much labour on her drawings, had not sought the best advice as to the way in which she might have made her pictures of value.

The notes supplied by Prof. Boulger are full of useful information and make pleasant, if not very strenuous, reading. We doubt, however, owing to the bulk of the book, if they will receive very serious attention. He has collected together a good deal of curious and out-of-the-way information under the different plants which it is well to bring to the notice of students and those interested in flowers. In addition to the ancient lore the correct naming of the plants is fully treated, and a considerable amount of recent work of interest is incorporated as occasion demands.

Information about the habitats and general condition of life of the different plants figured is also given. In the introduction a useful outline of general floral morphology and classification is to be found, and the plates with their pages of text follow. The plants figured in the volume include the British conifers, certain monocotyledons, the willows, oak, beech, and allied trees, the nettles, Polygonaceæ, Caryophyllaceæ, and a few others.

PHYSICAL CHEMISTRY.

(1) *The Theory of the Solid State.* Based on Four Lectures delivered at University College, London, in March, 1913. By Prof. W. Nernst. Pp. viii + 104. (London: Hodder and Stoughton, 1914.) Price 2*s.* 6*d.* net.

(2) *Lehrbuch der physikalischen Chemie.* By Dr. K. Jellinek. Band i. Die Lehre von den Aggregatzuständen, Teil I. Pp. xxxvi + 732. (Stuttgart: F. Ende, 1914.) Price 24 marks.

(3) *Complex Ions in Aqueous Solutions.* By Dr. A. Jaques. Pp. vi + 151. (London: Longmans, Green and Co., 1914.) Price 4*s.* 6*d.* net.

(1) THOSE who had the opportunity of hearing Prof. Nernst deliver his short course of lectures at University College, London, on the Quantum Theory as applied to the solid state of matter will welcome this somewhat belated publication. The book is a masterpiece of lucid condensation, covering as it does in a small number of pages the whole range of modern work on the thermal properties of solids. The limitations of the Dulong-Petit generalisation are briefly discussed. The necessity for the introduction of some new hypothesis in place of equipartition is made clear, and the fortunate application of Einstein of the Planck quantum concept to the heat capacity of vibrating atoms is shown to point the way to a new understanding of the baffling problem of the solid state. The Nernst-Lindemann empirical modification of the Einstein formula is touched upon, and later the more theoretically significant expression of Debye.

Whilst fully realising the great progress which has been made by the introduction of the quantum theory to the thermal properties of solids (and gases and liquids for that matter), it would be idle to pretend that everything is at present on a sure and certain basis. As a matter of fact nearly every stage bristles with assumptions, and although the general trend is certainly in the right direction, not a few of the assumptions are mutually conflicting. A science in this state is, however, just at its most attractive stage, and the number of investigations cited as references in the book are ample evidence of the interest which the subject has awakened, especially in Germany.

An important feature of the book is the good account of the experimental methods employed in the Berlin laboratory for the determination of specific heats, especially at very low temperatures. Perhaps the most interesting section is that entitled "General law respecting the behaviour of solid bodies at very low temperatures," in which a most suggestive account of present and future problems is given on such subjects as thermal expansion, compressibility, conduction of heat and electricity, thermal e.m.f's, and magnetic susceptibility. It would seem that before long the subject of thermal and electrical conductivity of solids will be a region of controversy between the electron view and the quantum view—which, it is to be hoped, will result in a clearer physical conception of what the quantum really is. It is noteworthy that no mention is made of Sommerfeld's views.

There is no question that during the next decade at least, the most active investigation in theoretical physics and chemistry will consist in the further extension and application of the quantum theory, hence the significance of the present publication which is a most excellent epitome of the subject (so far as it refers to solids), by

one who is himself one of the pioneers in its development.

(2) The bulky volume before us represents vol. i. of a Text-book of Physical Chemistry to be completed in four volumes. The author, Dr. Karl Jellinek, has indeed no light task before him in thus undertaking a work which is intended to be an Ostwald Lehrbuch brought up to date, and written in even greater detail than its prototype. Dr. Jellinek's repute, however, as an investigator and a writer—it seems only the other day that a large and very valuable work on a branch of physical chemistry appeared from his pen—entitles us to expect that the present book when completed will succeed in fulfilling the author's expectations. As is stated in the preface, stress is laid (though not unduly) upon the physical aspect of the subject, and the fact that two large volumes are to be devoted to the consideration of states of matter (in the widest sense) is evidence of this.

Vol. i commences with a very full account of literature sources (text-books of all kinds and journals) this being followed by an introductory chapter dealing with the principles of the kinetic theory and thermodynamics. Next comes the subject matter proper, beginning first with an account of the gaseous state (pp. 160–431), transition from gaseous to liquid (pp. 432–468), and the liquid state itself (pp. 469–711). In vol. ii., which is promised shortly, the liquid state will be still further considered, and after that the solid state and dilute solutions. As illustrating the extent of detail one may quote the table of contents of the principal chapter included in the first subsection (dilute gases) of the section dealing with the gaseous state in general, viz., the Maxwell distribution law, rigid deduction of the gas law, degrees of freedom, rotation of gas molecules, vibration of atoms in gas molecules, law of equipartition of energy between degrees of freedom inside a molecule, theory of the specific heat of dilute gases. The liquid state is considered in equal detail. A book written authoritatively as this undoubtedly is, and on this scale of minuteness, is bound to become an indispensable work of reference for all physical chemists.

(3) Dr. Jacques's monograph on complex ions in aqueous solution is an eminently useful publication. Five chapters are devoted to the principal methods of detecting and determining complexes, viz., the chemical method, distribution method, ionic migration method, solubility method, and e.m.f. method. The remaining chapters deal with applications of these methods to various cases, notably the complex mercury salts, ammoniacal solutions of metallic salts, salts of cobalt and copper (including Fehling's solution), equilibrium between metallic ions at different degrees of oxidation, polyiodides and sulphides (the latter being particularly well treated). The appendix contains a brief account of the hydrate theory and a general scheme for treating complexes theoretically. Great stress is laid upon the significance of equilibrium constants and their numerical evaluation. The book can be warmly recommended. W. C. McC. L.

OUR BOOKSHELF.

Agriculture in the Tropics. An Elementary Treatise. By Dr. J. C. Willis. Second edition, revised. Pp. xvi+223. (Cambridge University Press, 1914.) Price 9*s.* net.

AGRICULTURE resolves itself mainly into a combination of the four factors, crops, soil, labour, and climate. Of these, in tropical countries crops are quite the most interesting on account of their diversity and high economic importance. There is therefore ample justification for the large amount of space—nearly half the volume—devoted to descriptions of the principal agricultural products; even then it is only possible to present general outlines of cultivation and preparation. The author draws largely upon his long and varied experience in Ceylon, also upon his personal knowledge of agriculture in Malaya and India. Soil problems do not receive much discussion; there is, for instance, little or no reference to modern soil science and we should have expected a fuller account of the practice and details of green manuring. The labour factor, on the other hand, especially peasant agriculture, is discussed very fully in the last seventy pages, with the object of describing native methods and considering how their efficiency may be increased. There is much soundness in the general opinions enunciated that before improvements are attempted, due regard must be had to the peasants' environment and scruples. Co-operative seed stores and education by school-gardens are advocated as the most hopeful remedial measures.

The value of the book lies largely in the original source and nature of the information supplied, based as it is upon intimate knowledge gained by many years' administration as director of the Botanic Gardens in Ceylon. The first edition of the book was published nearly five years ago.

Chemical Technology and Analysis of Oils, Fats, and Waxes. By Dr. J. Lewkowitsch. Fifth edition, entirely re-written and enlarged. Vol. ii. Pp. xiv+944. (London: Macmillan and Co., Ltd., 1914.) Price 25*s.* net.

THE second volume of this well-known work deals with the commercial preparation of the raw materials used in the oil, fat, and wax industries, and with the methods of preparing and examining the individual oils, fats, and waxes. For the fifth edition a competent editor appears to have been found in Mr. G. H. Warburton, who was associated with the late Dr. Lewkowitsch's ana-

lytical practice for a number of years. The work as a whole was reviewed in these columns on the occasion of the previous issue, and its general plan remains unchanged, though the matter has been re-written and many additions made. These include, in the volume under notice, a number of hitherto unpublished results obtained in the author's laboratory, and also data respecting certain oils such as those from perilla seed and rubber seed which, though little known in this country at present, may perhaps prove of commercial importance in the future. There are also some revisions of the older values for the physical and chemical "constants" in cases where the adoption of improved processes for the preparation of oils and fats has rendered the earlier figures obsolete. The volume, in fact, appears generally to have been brought well up to date, and users of the work will find the new edition increasingly serviceable.

Flintshire. By J. M. Edwards. Pp. xi+172. *Peebles and Selkirk*. By G. C. Pringle. Pp. x+149. (Cambridge University Press, 1914.) Price 1*s*. 6*d*. net each.

ATTENTION has been directed on several occasions to the attractiveness and utility of the Cambridge County Geographies. These recent additions to the series have been bound in a new form, which makes them very convenient for use as guide books, a purpose they will be found to serve admirably, without in any way interfering with their popularity as interesting supplements to geography lessons in schools. Both authors may be congratulated upon maintaining the high standard set in previous volumes.

THE AUSTRALIAN ANTARCTIC EXPEDITION.

THE scientific value of the Australian Expedition, described by Sir Douglas Mawson in the September number of the *Geographical Journal*, though obtained by great toil and hardships, which were almost fatal to the leader and led to the tragic deaths of two of his companions, promises to be very great. Before this expedition, as the maps show, little was certainly known about the Antarctic continent for quite 70° of longitude; from some distance west of Cape Adare to the winter quarters of the *Gauss* in 1902–3. The geography of this, as the maps show, has now been ascertained by adventurous and laborious sledge journeys from the two bases occupied by Mawson's expedition, and the following are its main results.

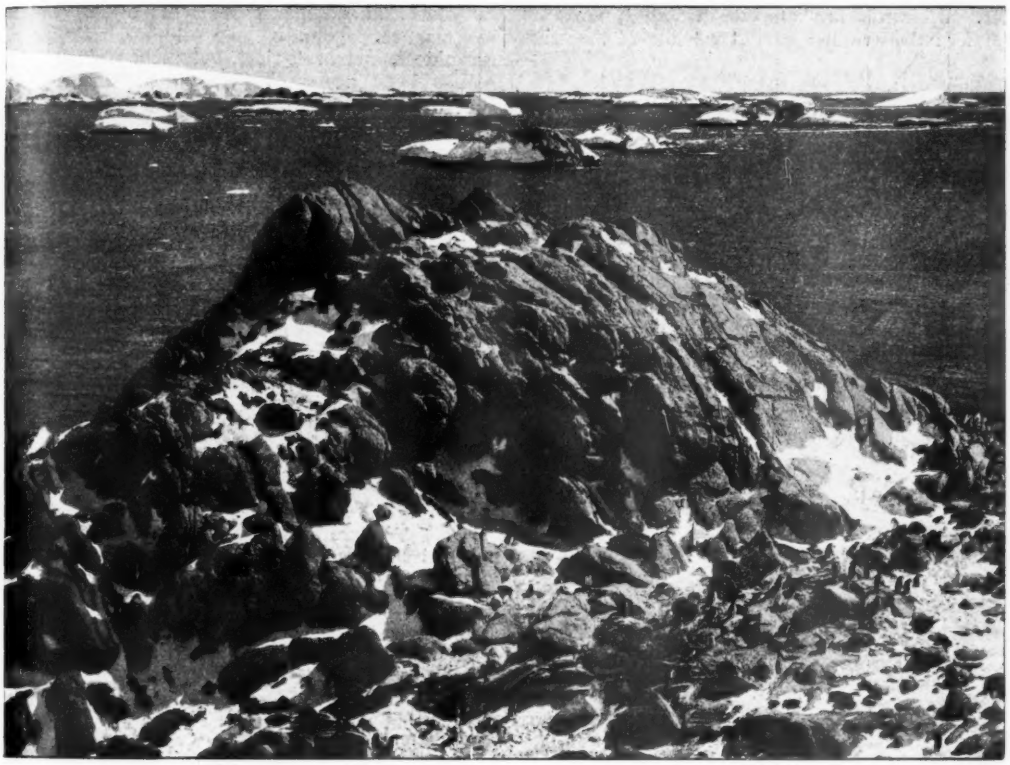

FIG. 1.—A view of the islets off the coast of the mainland looking west from Stillwell Island, Adelie Land. From the *Geographical Journal*.

Macquarie Island, a link between Tasmania and South Victoria Land, on which a party was

left in charge of the wireless telegraph station, has been surveyed and its natural history studied. Here, and on the mainland, rare seals, fish, and numerous birds were obtained, with a large collection of eggs, most of which were previously unknown. Sounding and dredging were carried on, with excellent results, in the sea between Australia and the Antarctic continent. The rocks of the mainland appear to be largely crystalline, probably Archæan, with some sedimentaries (among which the Beacon Sandstone apparently occurs), containing coal and carbonaceous shales. Capping them are great masses of columnar dolerite (Fig. 1).

The climate of all the region explored seems to be even worse than that in the Ross Sea district. Blizzards are almost incessant, even in summer: the average annual velocity of the wind

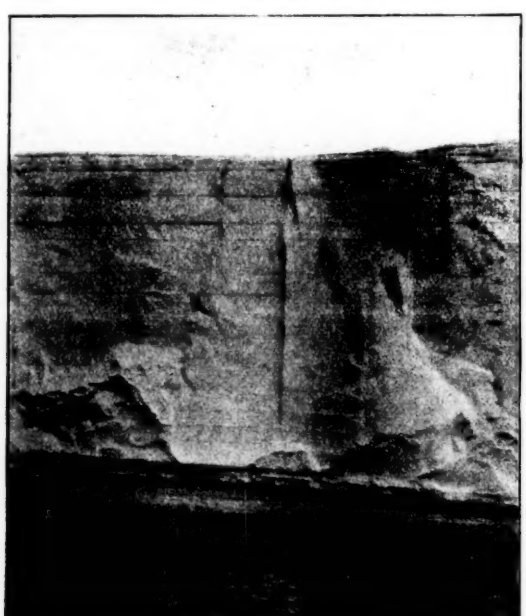

FIG. 1.—The face of the Shackleton Shelf. Each band represents an annual snowfall addition. From the *Geographical Journal*

being 50 miles an hour, and it often rises to above 100 miles. In winter the air is full of particles of ice, and the electricity generated is so great that hands, noses, and projecting parts of the clothes show pale gleams like St. Elmo's fire.

This portion of the Antarctic continent seems to be less mountainous than South Victoria Land, but its snowfields rise inland to heights of from 2000 feet to above 4000 feet; one of the exploring parties attaining in that direction an elevation of nearly 6000 feet. An ice barrier, like the well-known one in Ross Sea (named Shackleton's Shelf) defends most parts of the coast, and gives a still more conspicuous instance than that affords of projecting tongues of ice formed by the huge land glaciers, which force their way through the barrier, and protrude many miles, in one case quite sixty, out to sea. In other words the barrier exchanges the piedmont for the more normal glacier type. But in other respects the history of this floating ice corresponds with that of the Ross Sea Barrier. Its upper part, probably all visible at its extremity, is not land-ice, but stratified frozen snow, as shown in Fig. 2, formed by the accumulated annual snowfalls: the great part of the original land-ice having been melted off by the sea-water. Thus the rock *débris* incorporated in the lower part of that ice (and in these regions there cannot be much in the upper) must be distributed over the sea bottom—a fact of which the advocates of the terrestrial origin of all boulder clays will do well to take cognisance. Thus a fine piece of work—geographical, meteorological, botanical and zoological—has been accomplished, and Australia, as in the case of the Funafuti boring, has done a most notable service to science.

T. G. BONNEY.

DETERIORATIVE CHANGES IN WINE.[1]

SINCE the time when Pasteur, in his "Études sur le Vin," described a certain bitterness sometimes occurring in wine (*Maladie de l'amertume*) as being apparently due to a specific micro-organism, most of the forms of deterioration which wine undergoes have been recognised as due to biological action. Thus the *Kahmigwerden*, the *Essigstich*, and the *Milchsäurestich* of German writers, the *poux* and the *graisse* of French œnologists, are ascribed to the undesirable activity of various bacteria, moulds, and yeasts. Sourness, for example, is often due to acetic acid produced by the ferment *Mycoderma aceti* from the alcohol of the wine; whilst another mycoderm (*M. vini*) is believed to produce faulty wine by attacking the cream of tartar and albuminous extractive matters.

Some of the faults which may develop in wine, however, are attributable to causes not primarily biological. A certain kind of mustiness, for instance, is ascribed to the effect of a malodorous essential oil. The presence of iron salts, again, has been recognised as a necessary condition for the appearance of a particular kind of turbidity—the *casse ferrique*—which in certain circumstances may affect white wines. With this phenomenon oxidation processes are known to be associated, and the intervention of an oxidase, transferring oxygen from the air to substances in the wine not directly oxidisable under ordinary conditions, has been suggested to account for the results observed.

Dr. Horace Brown has studied at considerable length a variety of *casse* to which the white wines of the Cape are particularly liable. Although the wines may have been bottled perfectly bright, they have a tendency to become

[1] "An account of some investigations on the White Wines of South Africa: an Œnological Study. By Horace T. Brown. *Journ. Inst. of Brewing*, vol. xx, No. 5.

cloudy and to throw out a light deposit. This tendency is accompanied as a rule by more or less darkening of colour, and by modifications in the flavour and odour which are very characteristic. Even before any *casse* or "break" (cloudiness) is observable in them, wines undergoing this change acquire an "earthy" odour or *terroir;* and simultaneously a distinctive bitter flavour of a greater or less intensity is developed. These faults—cloudiness, earthy odour, bitterness, and modification of colour—may exist in different degrees, but are apparently all related to a common cause; and Dr. Brown's experiments indicate that this cause is not to be sought in the action of micro-organisms. The malady is conditioned by purely chemical changes. Moreover, it only occurs when the wine is in contact with air, or with free oxygen derived from some such source as hydrogen peroxide.

Naturally one of the first things to ascertain in studying the malady was the true character of the suspended matter forming the turbidity. Under the microscope it was found to consist of amorphous aggregates of minute, roughly-spherical particles, which were readily stained by Coupier's blue, dissolved easily by caustic alkali, and also, though with some difficulty, by dilute acid. Except in this last point the deposit resembles the amorphous matter which separates from beer in certain circumstances, and which has been shown by Dr. Brown himself to consist mainly of a combination of tannic acid with albuminoids. The actual amount of the deposit necessary to give a distinct turbidity to wine is relatively very small: in one instance the weight of the substance when dried was only 6·4 milligrammes per litre of wine. The organic portion of the deposit contained nitrogen equivalent to 55·9 per cent. of albuminoids. When incinerated, the dry substance of the deposit yielded 12·9 per cent. of inorganic material, four-fifths of which was ferric oxide. In fact, a striking feature about all the deposits in this kind of *casse* is the comparatively large proportion of iron which they contain.

It was found, further, that an essential factor in the production of *casse* was the presence of a little iron in the *ferrous* state. This apparently acts as a carrier of atmospheric oxygen to certain oxidisable substances in the wine, much in the same way as traces of ferrous salts behave in the well-known "Fenton" reaction.

Systematic experiments showed not only that air and ferrous salts are necessary, but that certain oxidisable substances in the wine are also required. Of these the most notable is tannic acid; and the author concludes that the material forming the turbidity or deposit is in fact "a colloidal combination of iron with products derived from the limited oxidation of tannins and certain wine-albuminoids." This does not, of course, tell us all that it is desirable to know about the deposit and the conditions of its formation. The question of the nature and amount of the nitrogenous substances in the wine, and the part they play in the production of the changes, has still to be investigated. As the author remarks, wine-making has its own particular "nitrogen question," and it is at present virgin ground.

Good evidence was obtained to show that the oxidising agent concerned is not a vegetable oxidase. Freshly expressed grape juice contains no oxidase, though it may dissolve some from the grape skins if left in contact with them. In any case there appears to be no connection between the occurrence of oxidase and the *casse ferrique*. The immediate cause of this deterioration is the alternate reduction and oxidation of iron, with consequent transference of oxygen to the changeable tannins and other constituents of the wine.

Now if this is true, it points the way to preventive and remedial measures. One such measure, obviously, is to avoid so far as possible the must or wine taking up iron at any stage of the making or storing. If, however, an excess of iron cannot be helped, it would be expected that the addition of a reducing agent to maintain the iron permanently in the ferrous condition would prevent the occurrence of the malady. This was found to be so, the action of sulphites in this respect being very pronounced. Again, since tannic acid is one of the essentials, its removal should be beneficial; and in fact the addition of casein to the wine has a favourable influence which is attributed to an adsorptive separation of tannin by the casein. As regards the other essential condition—the presence of air—the author recommends that aeration of the wine should be guarded against during the maturing and bottling operations, and that the bottles should be completely filled. In this connection it is noted as unfortunate that the visitor to the Cape generally makes the acquaintance of South African wines for the first time on the ship going out. The bottles are frequently not completely filled, and this, with the alternations of temperature and the swing of the ship, helps to produce the malady in question, especially in the more delicate white wines.

The faults mentioned are so common in the white wines of South Africa that the author at one time regarded them as due to some fundamental causes, such as soil and climate, which were beyond control. But the occurrence of perfectly "clean" wines, the production of such wines under his own auspices, and the results of the investigation which has been outlined, have altered this view. Not Providence, but the producer, is responsible—or at least, the producer and the merchant must share the responsibility.

The scientific study of this question made by Dr. Brown, necessarily incomplete though it is, has given definite knowledge where hitherto information has been vague or absent, whilst the practical application of this knowledge indicates the direction in which remedial measures are to be sought. It is to be hoped that the author will be able to extend the research to the "nitrogen question" already mentioned, and with equally definite results.

C. SIMMONDS.

A PHYSIOLOGICAL PUZZLE.[1]

WHAT the magicians did in ancient days before Pharaoh in the way of turning sticks into snakes has often been done since, or its converse of turning snake into stick, but it remains in great measure a physiological puzzle. If the cobra in its threatening attitude be deftly caught behind the head and gently pressed, it soon becomes stiff, and will remain so for a considerable time, either coiled up or drawn out straight. It has passed into the strange state of animal hypnosis. In 1646 the Jesuit father, Athanasius Kircher, described the famous experiment, "de imaginatione gallinæ." He laid a hen on the table, held it firmly for a little, and drew a chalk line in front of its eyes, with the result that it remained as if in katalepsy. Czermak showed in 1872–3 that this could be done with many birds, and that the chalk line was quite unnecessary. The veteran entomologist, Fabre, tells us that he and his school companions used to put a whole flock of turkeys to sleep with their heads tucked under their wings. Animal hypnosis can also be induced in mammals (guinea-pig, rabbit, mouse, squirrel, bat, dog, cat), and this is usually effected experimentally by fastening them to a board and turning this suddenly upside down. Frogs are readily susceptible, and newts will also submit.

In backboned animals the state of immobility is scarcely known except in artificial conditions, and can scarcely be of much importance in life. It is otherwise, however, when we pass to the analogous "death-feigning" or katalepsy in certain beetles, water bugs, stick-insects, and spiders. The immobility occurs in natural conditions, and it seems often to save the life. The case of the female Galeodes is of special interest, since the more than recalcitrant female passes into a convenient hypnosis when she is suddenly seized by the weaker male. This may be induced artificially in the sexually mature female by gripping her suddenly in the dorsal region of the abdomen with a pair of fine forceps and raising her from the ground. She remains quite passive until she is restored to earth. It is very interesting to note that older females, who have paired, do not pass into katalepsy, but turn fiercely on the forceps. In the same connection it is worth recalling that when we lift a shore-crab, holding the shield between finger and thumb, and wave it in the air, it becomes immobile, but the two sexes dispose their limbs in different ways, the female bending them in over the abdomen, as if protecting the eggs. The familiar case of the fresh-water crayfish is interesting, because the creature does not pass suddenly into hypnosis, but usually resists for a considerable time. It may be fixed in any position of equilibrium—on its head, on its back, or even in its normal pose. The stick-insect, Dixippus, which feeds at night, normally assumes its protective immobile attitude under the stimulus of light, but a mechanical stimulus also serves. Schmidt has recently shown that the insect can be fixed in any grotesque attitude for hours on end. It has been shown that the transition from one state to the other can in this creature be effected almost in a moment.

In a case like the stick-insect we cannot but regard the kataleptic habit as of protective value; it adds to the safety which the protective form and the protective colour also help to secure. The creature behaves as if it knew, for it almost always disposes itself parallel to the twig to which it is attached. Schleip also points out that when it lets go on being touched, the elongated, straight disposition of the appendages makes it easier for it to slip down among the twigs. In Galeodes, as we have noted, the sudden passivity of the female is of importance in reproduction, and a similar phenomenon has been observed in the female octopus. In many cases, however, it seems quite impossible to maintain that the katalepsy is protective at all. Thus Fabre notes that *Scarites buparius*, one of the large ground-beetles, which a shake sends into a lasting katalepsy, is voracious, well-armoured, nocturnal, and unpalatable. What has it to do with "death-feigning"? Cases of this sort suggest that the kataleptic tendency may be simply a concomitant of a certain type of nervous constitution, and that it is only occasionally turned to advantage.

According to Mangold, the characteristics of human hypnosis are: that it is a sleep-like state, induced by suggestion; that it implies a rapport between the hypnotiser and the patient, and an increased amenability to suggestion; that it involves an inhibited power of locomotion and of "righting" the body, a change in muscular tonus—from initial increase to somewhat sudden decrease—and a change in sensitiveness which may amount to anæsthesia and analgesia. Suggestion is a psychically-conditioned effect, for which the physiological stimulus seems to be inadequate. Little is known in regard to the hypnosis of the highest animals, like dogs and cats, the amenability of which to human influence is well known, but in ordinary cases it may be concluded, according to Mangold, that animal hypnosis differs from man's in the absence of the suggestion, the rapport, and the deeper stages. It may be induced in animals without a cerebrum, which indicates that the psychological factor is unimportant. Physiologically considered, however, the more typical forms of animal hypnosis must be ranked beside human hypnosis, and studied in this light.

The resemblances are many. The sleep-like state is induced in man by suggestion or psychical inhibition, in animals by mechanical inhibition, but in both cases sensory stimuli may assist. These stimuli may be optic (fixing the gaze on some object), or tactile (stroking the skin), or otherwise. Sometimes an absence of wonted stimuli may induce the state, as in the case of absolute silence. The awakening may be brought about by sounds, shaking, currents

[1] "Hypnose und Katalepsie bei Tieren im Vergleich zur menschlichen Hypnose." By Ernst Mangold. Pp. 82+18 figs. (Jena: Fischer, 1914). Price 2.50 marks.

of air, or electric shocks; or it may occur spontaneously. There is great specific and individual diversity in susceptibility; the easier the inducing of the hypnosis, the deeper and more lasting it is. The muscular tonus changes characteristically (now great stiffness and again "waxy flexibility"); resistance to fatigue is increased. Reflexes are to some extent affected by the altered tonus. Sensitiveness to touch and to pain may be greatly lessened, and operations may be performed during hypnosis. But the senses remain awake, and, except in the deeper phases in man, memory partly persists. Anæmic symptoms are sometimes observed, but there is no regular alteration in the everyday functions, such as the beating of the heart or the respiratory movements. Since animal and human hypnoses agree in all these respects, Mangold has confidence in his thesis that they are thoroughly analogous phenomena.

Finally, in his interesting study, he proposes a classification :—

1. Experimental hypnosis induced by psychical inhibition (suggestion hypothesis): (*a*) in man, and (*b*) perhaps in some of the highest mammals;

2. Experimental hypnosis induced by mechanical inhibition: (*c*) in mammals, birds, reptiles, and amphibians, and (*d*) in crustaceans and insects;

3. Natural hypnosis induced by "biological" stimuli: (*e*) death-feigning in crustaceans and insects, and (*f*) katalepsy in stick-insects.

DEEP SEA EXPLORATION.[1]

IN their book entitled "The Depths of the Ocean," which was noticed in NATURE of October 24, 1912, the late Sir John Murray and Dr. Hjort gave a general account of the expedition of the *Michael Sars* in the North Atlantic, and discussed the most striking results which had been obtained. The material collected had, however, been only partially worked out when that book was published. The more detailed scientific reports are now to be issued in a series of volumes containing memoirs by different specialists. The present volume is the first of these reports to be published, and deals with some of the zoological results of the expedition.

The Cephalopoda are described by Prof. C. Chun. A large number of species were obtained, several of which are described as new, but perhaps the most interesting feature of the collection is the series of early stages of *Spirula australis*, Lamarck. These were obtained in the neighbourhood of the Canary Islands, where they were taken in plankton nets. There were three larval stages, of which the youngest is 6 mm. long and has five chambers projecting at the posterior end of the body; the next has six visible chambers, and the third is 9 mm. long with seven chambers. In addition to these larvæ, young stages with dorsal mantle lengths of 12 mm., 16 mm., 18 mm., 23 mm., and 26 mm. respectively were obtained. Excellent figures of the external appearance of these larvæ and young stages are given. Their internal anatomy has not, however, yet been examined. The memoir ends, to use Prof. Chun's own words, "with the description of a new and wonderful type of Cirroteuthidæ, which may probably be counted among the most valuable spoils of the expedition. The specimen is a perfectly gelatinous, semi-transparent cephalopod, the fragility of which recalls that of a ctenophore." To this interesting animal, which is fuly described and well-figured, the name of *Cirrothauma Murrayi, n. gen.* and *n. sp.* is given.

The Cirripedes are described by the late Dr. P. P. C. Hoek, the forms obtained being all previously known, and Dr. Kr. Bonnevie deals with the Pteropods. Dr. Bonnevie's memoir contains an elaborate and useful discussion of the two species *Limacina balea* and *L. retroversa*, about which very great confusion has existed. Dr. Bonnevie shows clearly that the two forms are distinct, and he describes the limits of variation in certain characters of the shell of each species.

The Scyphomedusæ, Pennatulacea, and Hydroida are treated in three memoirs by Dr. Hjalmar Broch. It is to be regretted that Dr. Broch commences his first paper by an unfortunately worded attack upon the scheme of plankton nomenclature which was introduced a good many years ago by Dr. G. H. Fowler. The "epiplankton" of Fowler is certainly not the same as the "meroplankton" of Haeckel, as Dr. Broch seems to think, but is that part of the "holoplankton" which lives between the surface and 100 fathoms. This is clearly explained in Steuer's "Planktonkunde" (p. 370), to which work Dr. Broch refers for support. Steuer himself would seem to have adopted Apstein's term "passiv limnetische Planktonten," for the forms in fresh water which attach themselves to other organisms, remarking that these forms *have been called* "epiplanktonic." In one instance (p. 616) only, so far as his index shows, he uses the term in the latter sense without qualification, and he nowhere gives any indication as to when or by whom it was first introduced. If it is shown that the word "epiplankton" had been employed in another sense previous to its use by Fowler, then it may be necessary to find a new term for what Fowler calls "epiplankton."

In the *Michael Sars* collections Dr. Broch finds ten species of Scyphomedusæ, of which two, *Nausithoë atlantica* and *N. globifera*, appear to be new, five species of Pennatulida and a considerable number of hydroids obtained partly from drifting sea-weed and partly from hauls of the young-fish trawl. An interesting figure, drawn by the artist on the *Michael Sars*, is given, in which an attempt has been made to represent the appearance of the Pennatulid *Umbellula güntheri* when in a state of phosphorescence.

The Murænoid Larvæ, which formed a most important collection, are described by Einar Lea. The general results as regards the occurrence of

[1] Report on the Scientific Results of the *Michael Sars* North Atlantic Deep-sea Expedition, 1910, carried out under the Auspices of the Norwegian Government and the Superintendence of Sir John Murray, K.C.B., and Dr. Johan Hjort. Vol. iii., part 1, Zoology. (Published by the Trustees of the Bergen Museum.)

the earliest larvæ of the common eel in mid-Atlantic, in the region south-west of the Azores, were first described by Dr. Hjort in the pages of NATURE (November 24, 1910), immediately after the return of the expedition. In the present memoir the preliminary description then given is extended, and a large number of other eel larvæ in various stages of development are described. An attempt is made, with considerable success, to correlate the distribution of the murænoid larvæ with the hydrographical conditions (salinity, temperature, and depth) at the positions where they were captured.

The last memoir is a short paper by Ørjan Olsen on the Pycnogonida, of which *Collossendeis michaelsarsi* and *Nymphon longituberculatus* are new, and are described in detail with good figures.

The volume is produced in excellent style, and the illustrations are without exception well done. The whole series of reports, it is explained, will comprise five volumes, the total cost of which will not exceed 20*l*. It is added that separate volumes will not be offered for sale, an arrangement which will probably seriously curtail the distribution, and consequently the usefulness, of the work. E. J. ALLEN.

BELGIAN PROFESSORS AND STUDENTS AT CAMBRIDGE.

UNIVERSITIES always have had small beginnings, and the attempt to build up an informal Belgian university at Cambridge is no exception to the rule. After the fall of Louvain, Cambridge formally asked the university authorities of that town to bring over such students and professors as could come with the view of carrying on their studies here, so that the continuity which every university greatly values should not be interrupted. It was the time of the Papal election, and Cardinal Mercier, the head of the University of Louvain, was away in Rome, and there was a good deal of difficulty in getting into touch with him, and before anything was settled Liège had also fallen. The hospitality of Cambridge was then extended to the university of that town. After some negotiations it was found impossible for either university to transfer its corporate and official existence beyond the Channel, and it therefore became impossible to attempt to organise official courses of study, to institute examinations, or to grant diplomas.

This, however, has not prevented the formation of unofficial courses, combining so far as possible systematic instruction on the lines of the Belgian universities with the individual requirements of refugee students and the restrictions of a necessarily rather incomplete Belgian teaching staff. The necessity of some kind of organised occupation was fully recognised, both by the professors assembled at Cambridge and by the Belgian Government. Cambridge hoped to take some part in protecting the students from the demoralising and dangerous consequences of enforced idleness—a condition likely to be prolonged for months even after the conclusion of the war, owing to the devastation of houses and property in the Belgian seats of learning.

The presence of professors representing almost all faculties has rendered it possible to form courses in several of them, though no one faculty can boast a quite complete organisation. The faculties of philosophy and letters (so important to a large section of students, viz., those who in ordinary conditions would just have entered upon their university education), and those of law and of engineering are so far the most favourably placed. Each of them is represented by several professors. Those who act as secretaries for their respective faculties are Prof. Carnoy (Louvain) for philosophy and letters, Prof. Dupriez (Louvain) for law, and Prof. Breithof (Louvain) for engineering. The faculties of medicine and science, represented by Prof. van Gehuchten (Louvain) and Prof. Colson (Louvain) respectively, are at present being organised, and the number of their students is constantly growing. It is hoped to organise the teaching in these faculties more completely with the assistance of professors who may feel disposed to take up their residence in Cambridge and to take their share in the direction of studies. A fairly large number of students of the commercial and consular sciences has also assembled, and as the published list of lectures shows this faculty is doing well.

It should also be mentioned that for each Belgian faculty "in being" there is a corresponding British committee consisting of a president and a secretary, whose pleasant duty it is to arrange lecture-rooms, libraries, laboratory facilities, etc., for both the Belgian professoriate and the Belgian students.

Cambridge has indeed room for far more Belgian students than she is likely to receive. Many of the colleges are more than half empty, and the Lodging-House Syndicate estimate that there are a thousand sets of students' rooms vacant in the town. The stout-hearted landladies are very patriotic, and they are willing to give board and lodging to Belgian students at the rate of 15*s*. to 20*s*. a week, which can scarcely be very remunerative to these stricken ladies. Everyone is willing "to do a bit," and only the other day a chimney-sweep after having finished his work at one of these lodging-houses turned to the landlady and said: "Got any Belgians here?" and when she said "Yes," replied: "Then I makes no charge."

Of course a large number of the professors and students are literally destitute, but the University has collected a certain sum which enables our honoured guests to be clothed and fed, and even to provide the students with pocket-money every Saturday morning.

One rule was adopted from the very beginning and has been rigidly adhered to, and that is, *that only such students would be helped at Cambridge who had papers showing that they were physically unfit for military service, or had been rejected for other reasons by the Belgian authorities.* All students, therefore, who wish to avail themselves of the hospitality offered by the University of Cambridge and of the courses arranged by the

Belgian professors are requested to present themselves for medical examination before the proper authorities, and to obtain, in the event of their being rejected, a certificate to that effect. These arrangements have been made after direct consultation with the Belgian Government, which was good enough to send to Cambridge some few weeks ago, from Havre, an ex-Minister of Justice, who clearly explained the view of the Belgian authorities, and these views have been loyally adopted and followed in Cambridge.

Any student who wishes to avail himself of the opportunities offered by Cambridge should communicate with Mr. J. T. Sheppard, King's College, hon. sec. of the General Committee, or Mr. E. Bullough, Gonville and Caius College, hon. sec. of the Academic Committee. Genuine students at Belgian universities, who are members of the Allied Forces, *i.e.* French, Russian, Japanese, Servians, Montenegrins, are welcomed on the same terms as the Belgians. All are expected to observe the not very rigorous rules of the university which for a time is their host. Students at Belgian universities belonging to neutral countries, Sweden, Spain, Mexico, etc., are welcomed, but they must pay their way.

Classes in English for Belgian students have for some weeks been in progress, and they are graded carefully according to the needs of our guests. Those who have an adequate acquaintance with our language are following the ordinary university courses.

As an example of what is going on we append the list of lectures for the engineering course, and that for the students in commercial science. It seems to be a custom of the Belgian universities to have one complete week-day holiday in the week, and this day is not the same day in the varying faculties. It may be of interest to those who read NATURE abroad to add a list of the resident Belgian professors in Cambridge, but this is necessarily incomplete.

Dr. Arien (Louvain), Prof. Bomerson, Prof. Breithof (Louvain), Prof. Carnoy (Louvain), Prof. Colson (Liège), Prof. Corbiau, Prof. De Groote, Prof. Déjace (Liège), Dr. Devigne (Liège), Prof. Léon Dupriez (Louvain), Prof. Van Gehuchten (Louvain), Prof. Gillet, Prof. Van Hecke (Louvain), Prof. Canon Van Hoonacker (Louvain), Prof. de La Vallée-Poussin (Ghent), Prof. Magnel, Prof. Nisot, Prof. N. Sibenaler, Prof. Steels, Prof. Van den Ven (professor of Byzantine Greek), Prof. Vanderstappen.

COURS ORGANISÉS À CAMBRIDGE POUR LES ETUDIANTS DES ECOLES D'INGÉNIEURS ET DE LA FACULTÉ DES SCIENCES.

A. *Ecoles d'Ingénieurs.*

(Local: Engineering Laboratory, Free School Lane.

LUNDI.—10h. à 11h. Calcul infinitésimal (Mr. V. Nisot). 11½h. à 13h. Résistance des Matériaux (traction, compression, cisaillement, flexion et torsion) (Mr. A. Van Hecke). 16h. à 18h. Géométrie descriptive, Géométrie descriptive appliquée, Graphostatique et travaux graphiques (Mr. F. Breithof). 16h. à 19h. Projets de résistance des Matériaux et de Stabilité des Constructions (Mr. Magnel).

MARDI.—16h. à 18h. Géométrie descriptive, Géométrie descriptive appliquée, Graphostatique et travaux graphiques (Mr. F. Breithof). 17½h. à 19h. Théorie du travail de déformation des solides élastiques (Mr. Magnel).

MERCREDI.—11h. à 13h. Essai des Matériaux (Mr. A. Van Hecke). 16h. à 19h. Projets de résistance des Matériaux et de Stabilité des Constructions (Mr. Magnel).

JEUDI.—11h. à 12h. Calcul infinitésimal (Mr. V. Nisot). 16h. à 18h. Projets de résistance des Matériaux et de Stabilité des Constructions (Mr. Magnel).

VENDREDI.—11h. à 13h. Essai des Matériaux (Mr. A. Van Hecke). 16h. à 18h. Projets de résistance des Matériaux et de Stabilité des Constructions (Mr. Magnel).

SAMEDI.—11h. à 13h. Stabilité des Constructions (Ponts et Charpentes (Mr. A. Van Hecke). 17½h. à 19h. Théorie du travail de déformation des solides élastiques (Mr. Magnel).

Mécanique appliquée (Mr. N. Sibenaler) aux jours et heures à déterminer. Matériaux de Construction (chaux et ciments) (Mr. A. Van Hecke), aux jours et heures à déterminer.

B. *Faculté des Sciences.*

(Local: Laboratoire de Chimie, Pembroke Street.)

MARDI.—11h. à 12h. Chimie organique (Mr. E. Colson).

SAMEDI.—11h. à 12h. Chimie organique (Mr. E. Colson).

Ces cours ne sont pas destinés à remplacer l'enseignement donné par les Ecoles d'Ingénieurs et par la Faculté de Sciences en Belgique, ni à préparer directement aux examens légaux. Ils ont pour seul but de maintenir les étudiants belges, réfugiés en Angleterre, dans les habitudes de travail et de contribuer à leur formation scientifique.

COURS ORGANISÉS POUR LES ETUDIANTS BELGES DES DIFFÉRENTES ECOLES SUPÉRIEURES DE COMMERCE.

Première Année.

LUNDI.—9h.–10h. Economie politique (Mr. Déjace). 10h.–11h. Sciences Commerciales: Comptabilité (Mr. Vanderstappen).

MARDI.—9h.–10h. Droit Civil (Mr. Bomerson). 10h.–11h. Sciences Commerciales: Arithmétique (Mr. Vanderstappen).

MERCREDI.—9h. – 10h. Sciences Commerciales: Comptabilité. 10h.–11h. Sciences Commerciales: Arithmétique (Mr. Vanderstappen).

VENDREDI.—9h.–10h. Droit Civil (Mr. Bomerson, à l'Ecole de Droit). 10h.–11h. Sciences Commerciales: Comptabilité (Mr. Vanderstappen).

SAMEDI.—9h.–10h. Sciences Commerciales: Algèbre financière (Mr. Vanderstappen). 10h.–11h. Economie politique (Mr. Déjace).

Seconde Année.

LUNDI.—9h.–10h. Economie Politique (Mr. Déjace). 10h.–11h. Sciences Commerciales: Fonds publics (Mr. De Groote).

MARDI.—9h.–10h. Sciences Commerciales: Comptabilité des Sociétés Commerciales (Mr. De Groote). 10h.–11h. Droit Commercial (Mr. Bomerson).

MERCREDI.—9h. – 10h. Sciences Commerciales: Algèbre financière (suite de 1re année). 10h.–11h. Sciences Commerciales: Comptabilité des Sociétés Commerciales (Mr. De Groote).

VENDREDI.—9h. – 10h. Sciences Commerciales: Algèbre financière (suite de 1re année) (Mr. De Groote). 10h.–11h. Droit Commercial (Mr. Bomerson).

SAMEDI.—9h. – 10h. Sciences Commerciales: Comptabilités spéciales (Mr. De Groote). 10h.–11h. Economie politique (Mr. Déjace).

Les cours de Sciences Commerciales se donnent à l'Ecole de Droit, Downing Street.

PROF. AUGUST WEISMANN.

THERE is a strange and peculiar pathos in the death of this great man, formerly the friend, we may hope to the last the friend, of so many English naturalists, and in the thought that the gulf which had opened between us can never be bridged. For Weismann was among those who publicly renounced the marks of distinction which had been conferred upon them in this country.

In the limited space which is available, it is only possible to touch upon the main subjects of Weismann's scientific career. His earliest researches were physiological and histological, the first publication, on hippuric acid (1858), being followed by a series of six papers on the nervous and contractile tissues (1859–1862). Abandoning this subject, except for a single paper on muscle published in 1865, he threw himself with the utmost energy into his classical work upon the embryonic and post-embryonic development and metamorphosis of insects, producing five memoirs between 1862 and 1864, and a sixth in 1866. In the great monograph on the post-embryonic development of the Muscidæ (1864) the building up of the perfect form in the pupa is studied in detail, and it is shown that, in insects with a complete metamorphosis, the tissues undergo a breaking down or histolysis into an apparently simple and primitive mass, from which the imago is built up afresh by, as it were, a second embryonic development. Thus the long series of slightly modified progressive steps by which, in the more ancestral groups, the earliest stage is transformed into the latest, has been shortened, in the more recent forms, into a single intermediate stage in which everything is broken down and built up again from the beginning, establishing the truth of Aristotle's statement that "the chrysalis has the potentiality of the egg."

Insect development was followed by a great series of memoirs (1874–1880) on the minute Crustacea—Daphnids and Ostracods—and these again by the epoch-making researches into the sexual cells of the Hydrozoa, published in four papers between 1880 and 1882, and, in 1883, in the great quarto monograph, "Die Entstehung der Sexualzellen bei den Hydromedusen." With the appearance of this work Weismann's eyesight became too weak for prolonged microscopic research, and he turned to other and more general problems of thought and inquiry.

Weismann was attracted early in his career towards the problems of the history and causes of evolution. "The Origin of Species" appeared in the year following the publication of his first paper, and in 1868 he brought out "Ueber die Berechtigung der Darwin'schen Theorie," followed in 1873 by his paper on the influence of isolation, written in answer to Wagner. The "Studien zur Descendenz-Theorie" (1875) included a variety of subjects treated from the evolutionary point of view—the seasonal dimorphism of butterflies, the markings of caterpillars, phyletic parallelism, the transformation of the Mexican axolotl, and the mechanical conception of nature. This important and stimulating work, translated into English with many additional notes by Raphael Meldola, and with a preface by Charles Darwin, was published in 1882. The present writer well remembers the interest with which he looked forward to the parts as they successively appeared, and the instant resolution to continue some of the lines of work.

The central thought which branched forth so luxuriantly during the last thirty years of Weismann's life sprang from his researches on the sexual cells of the Hydrozoa. By these he was led to conclude that, however ordinary their appearance, the germ-cells contain something essential for the species, something which must be carefully preserved and passed on from one generation to another. It was this conclusion, so Weismann told the present writer in 1887, which led directly to the hypothesis of "The Continuity of the Germ-plasm," with all its far-reaching consequences. In Darwin's pangenesis the germ-cells are derived from the body-cells, whereas in Weismann's contrasted hypothesis the body is an outgrowth from the germ. From this conception Weismann was led to contrast the mortal soma with the potentially immortal germ, and to question the hereditary transmission of acquired characters. Excluded from the Darwinian interpretation of germinal variation as a consequence of gemmules dispatched to the germ by environmentally modified body-cells, Weismann looked for the origin of variation in the kaleidoscopic combination of innumerable ancestral factors brought about by sexual reproduction. He thus sought to explain the meaning of sexual reproduction itself as well as the events which lead up to the fusion of the male and female germ-cells.

The subjects thus briefly enumerated, treated in eight memoirs published between 1881 and 1888, were translated and appeared in a collected form in this country as "Essays upon Heredity and Kindred Biological Problems" (1889). The translation of four additional memoirs (1886–1891) was published as a second volume in 1892, the year in which he produced "The Germplasm," translated by Prof. W. Newton Parker, and published in this country in 1893. An elaborate and remarkable hypothesis, "Germinal Selection" (1896) was followed by the comprehensive treatise on the evolution theory, which brought his long and fruitful life-work to a close. The two volumes passed through three editions between 1902 and 1913, the English translation by Prof. and Mrs. J. Arthur Thomson appearing in 1904, the year of the Festschrift, which celebrated Weismann's seventieth birthday.

Weismann was a naturalist keenly interested in living nature, as may be inferred from "Das Thierleben im Bodensee" (1877), the fruit of many a holiday spent in the study of aquatic life. He was a delightful and sympathetic companion, possessed of a noble simplicity. To younger men he was generous and sympathetic, and many will remember the encouragement they received from

his kindly appreciation. Apart from scientific work Weismann found his chief recreation in music, and with Huxley he could quote Landor's line—

I warmed both hands before the fire of life.

Throughout a long and energetic life Weismann worked with enthusiasm and success at the subjects nearest to his heart. Many have done the same, but there are few whose chosen labours have done so much to stimulate the work and the thought of others. E. B. P.

NOTES.

THE collections made by the well-known naturalist and sportsman, Mr. C. V. A. Peel, during the travels and hunting expeditions of twenty-four years, have for long formed a centre of attraction in the city of Oxford. They are housed in a specially-built museum in the Woodstock Road, and include many objects of considerable scientific interest. Among the mammals preserved in the collection are well-mounted examples of the African and Indian elephants, a fine head of the so-called "white" rhinoceros, and a good specimen of the Somaliland eland. Many other species of African antelopes are well represented. The collections are also rich in birds, reptiles, and fishes, the latter including some fine and well-preserved examples of the Salmonidæ. The insects and arachnida, several of which were new to science, collected by Mr. Peel in the "horn" of Africa during the years 1895 and 1897, formed the subject of a paper in the Zoological Society's Proceedings for 1900. His adventurous journeys in that region were fully described by him in his book, "Somaliland," published in 1899. The more important invertebrate captures have been lodged in the Hope Collection at Oxford, and in the British Museum (Natural History), but the remainder, together with the extensive series of vertebrates above referred to, and the building in which they are displayed, have now been generously presented by Mr. Peel to the city of Oxford.

IN reply to a question as to British manufacture of synthetic dyes asked in the House of Commons on Monday, November 23, Mr. Runciman said:—"Since the beginning of the war the earnest attention of his Majesty's Government has been given to the best means of averting the grave danger of stoppage of employment in the textile and other industries which depend upon a supply of colours owing to the interruption of imports from Germany. Emergency measures are already being taken to secure for the time being the continuity of supply of dyestuffs by encouraging the immediate development of existing sources in the United Kingdom and elsewhere. In addition, however, the inquiries of the Government have led them to the conclusion that the excessive dependence of this country on a single foreign country for materials of such vital importance to industries in which millions of our workpeople are employed constitutes a permanent danger which can only be remedied by a combined national effort on a scale which requires and justifies an exceptional measure of State encouragement. Accordingly the Board of Trade has entered into consultations with the principal interests concerned with a view to the elaboration of a scheme for the establishment of an undertaking for the production of synthetic dyes and colours. In the main it is hoped that the capital required will be forthcoming from the industries by which dyes and colours are mainly used, but the Treasury is prepared within certain limits, and subject to certain conditions, to afford financial support to a well-considered scheme which will be permanently under British control. I am not prepared at the moment to enter into fuller details, because several matters are still the subject of confidential negotiations, but further information will be made public as soon as practicable."

THE death is announced, at sixty-six years of age, of Dr. G. F. W. Thibaut, registrar of the University of Calcutta since 1906, and formerly assistant to Prof. Max Müller, in the preparation of the later volumes of the great edition of the "Rig Veda," as well as the smaller text edition, and principal of the Muir Central College, Allahabad.

WE regret to see the announcement of the death on November 20 of Dr. J. Burney Yeo, Emeritus Professor of Medicine, King's College, London, and author of "A Manual of Medical Treatment," "Food in Health and Disease," "The Therapeutics of Mineral Springs and Climates," and numerous articles and papers published in medical and other journals.

THE death is announced from Bulawayo of Mr. R. N. Hall, author of "Prehistoric Rhodesia" and a number of papers on South African races and traditions. Mr. Hall arrived at the conclusion that the old mines and ruined temples of Rhodesia, including the Zimbabwe temple, date from ancient times, and were due to Semitic immigrants—a view opposed to that reached by Dr. R. Maciver in "Mediæval Rhodesia," in which it is held that the buildings at Zimbabwe are the work of a native race of comparatively modern times.

THE most important contribution to the August issue of the *National Geographic Magazine* is an account by Messrs. Ellsworth and Emery Kolb of their experiences in the Grand Cañon of Arizona. The writers have lived for twelve years at the head of the Bright Angel trail, and from this point have made repeated excursions into this stupendous gorge. The first part of the article describes a trip to what is considered the most beautiful of the tributary cañons, that of Cataract Creek; the second an exploration of the cañon of the Little Colorado; the third a repetition of Major Powell's famous journey down the Green and Colorado rivers. The article is illustrated by a splendid collection of photographs procured at imminent risk to life and limb. The monograph fully describes the geography, scenery, and geological features of this remarkable gorge.

IN the issues of the *National Geographic Magazine* for September and October, the immense stock of photographs at the disposal of the National Geo-

graphic Society of Washington has been drawn on to supply a more vivid and instructive record of the countries engaged in the present war than has hitherto appeared in any British publication. France, Belgium, Germany, Hungary, and England are each in its turn illustrated by admirable views of scenery, architecture, and country life. Prof. R. G. Usher, professor of history in the University of Washington, dealing with England, "the oldest nation of Europe," gives a survey of its historical progress and industrial resources in relation to the present war. He sums up the situation by remarking: "While no one who is truly candid will deny that England has still much to attain in political and social consciousness and a long road to travel before the national consciousness will become instinctive upon aught but the simplest subjects, he will still be compelled to admit that England has progressed further in spiritual national consciousness than any other community in the world simply because the early attainment of territorial and racial unity enabled the ancestors of the present Englishmen to begin living together long, long before the final elements of other nations had been assembled."

An interesting phase in the evolution of art is discussed by Mr. F. G. Speck in his monograph on the double-curve motive in north-eastern Algonkian art, published as Memoir 42 by the Department of Mines, Canada. After fully describing, with abundant illustrations, the development of this form of decoration, he arrives at the conclusion that we find in it an originally non-symbolic decorative element, presumably an indefinite plant or floral figure, common to all members of the north-eastern Algonkian group both north and south of the St. Lawrence. Passing from this primary area, the motive has been borrowed by other western tribes, mostly Algonkian, and subjected to local modification. Among the Penobscots and perhaps their eastern neighbours the double curve has acquired, to a certain degree, a symbolic value due to contact with the more politically complex Iroquois. These positions, he admits, may require modification when the study of symbolism among the tribes east of the Penobscots, and the inter-relation between their art as a whole and that of the Iroquois, come to be more carefully investigated.

The twenty-second report of the Board of Health on leprosy in New South Wales for the year 1912 has been issued. On January 1 of that year only eighteen persons remained under detention at the lazaret. During the year five persons were reported to the Board as being suspected lepers, of whom four were certified as suffering from leprosy. Details are given of the condition of these new patients and of the methods and results of the treatment of the old cases.

The National Council for Combating Venereal Diseases was inaugurated at the Royal Society of Medicine on November 11. The gathering was a distinguished one, and representative of widely different interests. The aims and objects of the council are the following:—(1) To provide accurate and enlightened information as to the prevalence of these diseases, and as to the necessity for early treatment. (2) To promote the provision of greater facilities for their treatment. (3) To increase the opportunities of medical students and practitioners for the study of these diseases. (4) To encourage and assist the dissemination of a sound knowledge of the physiological laws of life in order to raise the standard both of health and conduct. (5) To co-operate with existing associations, to seek their approval and support, and to give advice when desired. (6) To arrange, in connection with such organisations, for courses of lectures, and to supervise the preparation of suitable literature. (7) To promote such legislative, social, and administrative reforms as are relevant to the foregoing aims and objects.

In the course of a paper on the birds of Costa Rica, published in the September number of *Zoologica*, Mr. L. S. Crandall remarks that the alleged scarcity and shyness of the brilliantly coloured king-vulture are not borne out by his experience, several of these birds allowing themselves to be approached within a distance of forty yards while feasting on a carcase. In a second article Mr. C. W. Beebe discusses the Himalayan and Far Eastern kalij-pheasants of the genus Gennœus, and concludes that the number of species has been much exaggerated.

At the conclusion of an article on the responses or reactions of animals and plants to stimuli—as exemplified by changes in function, structure, and colour induced, either directly or indirectly, by external conditions—published in the *American Naturalist* for November, Prof. V. E. Shelford remarks that, in his opinion, the doctrines of purposeful advantageous response, of natural selection, and of the continuity of the germ-plasm cannot be accepted in their entirety. "Each appears to have arisen from a recognition of certain more or less unconsciously selected and uncritically determined phenomena by each of several men who secured different facts and attempted explanations."

In the November number of *Wild Life*, Mr. Russell Roberts, who, we believe, is now serving with the army, resumes the account of his personal experiences of African big game, dealing in this instance with the black rhinoceros, of which several striking photographs are given. The author totally discredits the alleged excessive ferocity of this species, remarking that reports to this effect are for the most part due to want of sufficient acquaintance with the animal. A wonderful photograph of a sedge-bird, by Mr. Lodge, and a second of waterfowl on the lake in Woburn Park are other features of this issue. An article on the Zoological Gardens is marred by the statement that certain Australasian marsupials range as far *east* as New Guinea.

San Francisco has started a new journal, to be published quarterly by the California Fish and Game Commission, under the title of *California Fish and Game*, the first number of which appeared in October. California, it seems, has not yet fallen into line with the neighbouring States in the matter of the prohibition of the sale of wild ducks and other wild table-birds; and it has been made a ground of complaint

that wild ducks reared in Oregon and Washington migrate into California, where they are ruthlessly shot and sold. A Bill was introduced into the local legislature last year with the object of remedying this state of affairs, but was defeated as the result of a *plébiscite*. The greater portion of the contents of the first number of the new issue is devoted to arguments in favour of amending the present anomalous condition of affairs.

WE have much pleasure in congratulating the Royal Zoological and Acclimatisation Society of Victoria on the attainment of its "jubilee." In the fiftieth report of the council, for 1913, it is stated that the first buildings in the then newly-formed gardens at Melbourne were erected in June, 1862. The early efforts of the society were entirely restricted to acclimatisation, and it was not until 1870 that "Zoological" was added to its title, and that foreign animals were imported solely for the purpose of public exhibition. Judging from the photographs in the jubilee report, the collection of such imported animals must now be a fine one, but to an English eye the greatest attraction of the Melbourne Gardens must be the native Australasian species, among which we may specially refer to a group of tree-kangaroos or tree-wallabies, photographed amid the branches of a tree, in the report.

ACCORDING to the report of the general meeting held on November 17, the Zoological Society is suffering severely from the collateral effects of the war, the number of visitors to the gardens during August, September, and October being 307,826, or 124,154 fewer than during the corresponding period of 1913. The total number of visitors during the year has so far been 1,011,526, and the take of gate-money 23,786*l.*, or a decrease in the number of visitors of 75,059 and in the receipts of 2879*l.*, as compared with the first ten months of last year. Nevertheless, the fact that on October 25 the number of visitors who had passed the turnstiles during the year reached a million is a record which has been equalled only twice during the last eighty-six years. Eighteen new fellows were elected, and twenty-one candidates for the fellowship or honorary membership and eight for the corresponding-membership were proposed. The number of fellows hitherto elected during the year is 263, or three fewer than in the corresponding portion of 1913, this being, however, an increase of forty-seven above the average at the corresponding date for the last ten years. During August, September, and October 620 additions had been made to the menagerie—444 by presentation, 51 by purchase, 58 on deposit, 29 by exchange, and 38 born in the gardens.

IN the *Ophthalmic Review* for September, Dr. Edridge-Green publishes a short account of his theory of vision, and adduces the facts and arguments which have led him to its adoption. According to this theory the cones are the only terminal perceptive visual organs, the function of the rods being confined to the formation and distribution of visual purple. Vision he supposes to take place by stimulation of the cones through the photo-chemical decomposition of the liquid in which they are bathed, this liquid being sensitised by the visual purple. As against the argument that the visual purple is absent from the macula lutea, the region of most distinct vision, he adduces two observations by Devereux Marshall and himself on the eyes of monkeys which had been kept in the dark for forty-eight hours before being killed. He states that in these circumstances the yellow spot was the reddest part of the whole retina owing to the diffusion of visual purple from the surrounding parts of the retina between the cones. It is a pity that these observations have not yet been confirmed. Assuming their correctness, Dr. Edridge-Green brings forward many other considerations which tell in favour of his view. An important point in his argument is the absence of qualitative difference between central and peripheral vision, and he is supported by Tschermak, Hering, Hess, and Garten in his assertion that the difference between the vision of foveal and parafoveal areas is merely quantitative. The difference between the sensibility of the light and dark adapted eye he shows to be analogous to the difference in the spectral distribution of chemical effect with varying intensities of illumination. Several subjective visual phenomena are shown by him to agree with the theory.

A USEFUL paper by Mr. B. C. Wallis entitled, "The Distribution of Rainfall in the North-eastern United States: its Causes and Results," is published in the *Scottish Geographical Magazine* for November, based upon observations contained in the annual report of the United States Weather Bureau. The area embraces districts in which corn, cotton, and tobacco are cultivated, and various maps and diagrams show by means of "equipluves," or lines of equal average rainfall coefficients or percentages, the areas and dates of the wettest and driest months, and consequently the districts where such industries can best be carried on. The diagrams show, among other things, (1) that the maximum rainfall occurs between 130 and 140 per cent. of the normal, and that the minimum occurs between 70 and 80 per cent. of the normal, and (2) that in the north the rise in the rate of precipitation is faster than the fall, while in the Ohio valley and to the south-east the opposite is the case. The method is admittedly not new; it is fully explained in the Quart. Journ. Roy. Met. Soc. for October last (p. 311), and in an instructive note (p. 322) Mr. C. Salter states that a very similar method (the results of which were embodied in a paper to the society on November 18) has been for some years adopted by the British Rainfall Organisation. The usual *monthly* rainfall averages are expressed as percentages of the *annual* value at each station; in this way some "exceedingly interesting facts" are disclosed, with many fewer stations than are necessary when dealing with maps of actual monthly averages.

AN abstract of the results obtained by Mr. H. L. Curtis, of the Bureau of Standards, during his tests of the resistivities of nearly seventy insulating materials, appears in the Journal of the Washington Academy of Sciences for October 19. In all cases contact with the material was made by means of mercury electrodes, and the effects of surface leakage were eliminated by the use of a guard ring. The temperature of the specimen and the humidity of the

surrounding air do not affect the order of magnitude of the results, but for the best insulators the time of application of the voltage has a serious influence on the values obtained. Some of the most useful results are :—Fused quartz, special paraffin, and ceresin, all over 10^{18}; micas from 10^{17} to 10^{13}; sulphur, 10^{17}; bakelite, 10^{16} to 10^{11}; glass, 10^{14} to 10^{12}; unglazed porcelain, 10^{14}; paraffined wood, 10^{12} to 10^{11}; marble, 10^{11} to 10^{9}; and slate, 10^{9} ohms per centimetre cube. One of the most noticeable features of the table given by the author is the great difference between the insulating properties of different specimens of materials going by the same name.

A VERY interesting example of an experimental steam engine and accessories has just been supplied to the Marine School, South Shields, by Messrs. W. Sisson and Co., Ltd., of Gloucester. An illustrated description of this engine appears in *Engineering* for November 20. The engine is of the quadruple expansion type, and has four cylinders operating on four cranks, set at such angles as to give the best balancing results. The arrangements permit of the engine being run as a triple-expansion or compound engine, as may be found expedient for experimental purposes. The high-pressure cylinder is jacketed, and is provided with Meyer's expansion gear, operating on piston valves. The first intermediate cylinder is also steam-jacketed, and has a piston valve of the maker's special labyrinth type. The second intermediate and low-pressure cylinders have single-ported, flat-faced slide valves. Each cylinder has Stephenson's link-motion reversing gear. The engine drives either a dynamo or a Heenan and Froude dynamometer. The air-pump is of the ordinary single-acting type, and the surface condenser is independent of the engine.

A GREAT deal of experience has now been acquired regarding the cost of operating and maintaining systems of substations required in electric railway installations, and Dr. H. F. Parshall read a paper at the Institution of Civil Engineers on November 17 having for its object the assisting towards the standardisation of electric railway substation practice. The number of independent variables when a complete system with substations has to be dealt with is so great that the mathematical expression, from which might be deduced the minimum cost, would in practice be open to some suspicion. Hence the author gives in the paper a complete balance-sheet embodying every item for each case; without any great amount of labour, the methods and results given may be applied to practically any class of electric railway installation. Curves are also given showing the arrangements of substations that will operate different train services on different electrical systems, and at various voltages with a minimum total operating cost. Curves are included illustrating the advantages gained by working at high voltages, and these confirm Dr. Parshall's view that with the present arrangement of rotary-converter substations, there is little advantage in a higher voltage than 2400 for the track conductor.

ERRATUM.—On p. 318, col. 2, line 9 from bottom, for "miles" read "metres."

OUR ASTRONOMICAL COLUMN.

COMET NEWS.—Comet Delavan (1913*f*) is a morning object but situated low down. The following two-day ephemeris has been communicated by the Observatory of Copenhagen, and is a continuation of that which appeared in the *Astr. Nachr.*, No. 4756 :—

Ephemeris 12h. Mean Time Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Nov. 25 ...	15 37 56 ...	+6 9·3	
27 ...	42 16 ...	5 2·0	... 5·2
29 ...	46 31 ...	3 56·5	
Dec. 1 ...	50 39 ...	2 52·6	... 5·2
3 ...	15 54 41 ...	+1 50·2	

Last week the elements and ephemeris of Lunt's comet (1914*d*) were given in this column. It seems that this comet was discovered independently by several observers, and the Lick Observatory Bulletin No. 262 gives the elements and ephemeris of Comet 1914*e* (Campbell), which refers evidently to the same object. In this bulletin it is stated that the first telegraphic announcement from the Harvard College Observatory described it as a bright comet seen in the southern constellation Doradus by Leon Campbell at Arequipa. As the ephemeris given in this column last week differs slightly from that printed in this bulletin, a portion of it is reproduced below :—

Greenwich Mean Midnight.

	R.A. (true) h. m. s.	Dec. (true) ° m. s.
Nov. 25·5 ...	21 54 45·0 ...	+9 58 43
27·5 ...	56 1·3 ...	10 19 52
29·5 ...	57 20·8 ...	10 40 28
Dec. 1·5 ...	58 42·9 ...	11 0 35
3·5 ...	22 0 7·7 ...	+11 20 17

In *Knowledge* for November, Dr. Crommelin gives an interesting account of former appearances of Encke's comet, together with a chart illustrating the approach of this object to Mercury about twelve days after its perihelion passage, which occurs on December 5 next. The comet, he states, is likely to be a conspicuous object in November. The following is a portion of the ephemeris which he publishes :—

Ephemeris for Berlin Noon.

	R.A. h. m. s.	Dec.
Nov. 26 ...	14 41 46 ...	−10 16
30 ...	14 57 33 ...	14 20
Dec. 4 ...	15 17 20 ...	18 3
8 ...	15 41 12 ...	21 18
12 ...	16 7 27 ...	23 54
Dec. 16 ...	16 34 6 ...	−25 50

Mr. Denning, in the *Observatory* for November, communicates a short article on Encke's comet, and gives a table of all the comet's returns, with the dates of its redetection and periods.

SPARK SPECTRUM OF NICKEL UNDER PRESSURE.—Attention has often been directed in this column to many investigations regarding the fact that the wave-lengths of spectrum lines, determined from measurements in the solar absorption spectrum, display small differences when they are compared with the measurements of the same lines in spectra secured from terrestrial light sources. Numerous observers have attributed these discrepancies to the effect of pressure, but more recently Mr. Evershed has ascribed the solar displacements to Doppler effects. It is of importance, therefore, to pursue the study of the effect of pressure on the behaviour of lines in spectra, and in this connection the investigation of the spark spectrum of nickel which has been completed by Mr. E. G. Bilham

(*Phil. Trans.*, Roy. Soc., Series A, vol. ccxiv., pp. 359–71) will be found a useful piece of research. In the present investigation the effect of pressures up to ten atmospheres above the normal atmospheric pressure has been studied, the work having been carried out at the Imperial College of Science and Technology at South Kensington. Details regarding the method employed, the spectroscope, measuring apparatus, etc., are stated briefly, followed by descriptions of the character of the lines studied, results of measures, classification of shifts, and the behaviour of some special lines.

Summarising the results, it may be stated that the lines exhibit a variety of behaviour, and have been divided into five classes depending on the types of reversal and broadening. The enhanced lines were observed to decrease in intensity and broaden symmetrically with increase of pressure. The general effect of pressure on the relative intensities of the lines is similar to that of including self-induction in the spark circuit; pressure also causes gas lines to disappear. The displacement of all lines is towards the red. The average shifts are the same for symmetrical as for unsymmetrical reversals, but the shifts are larger for unreversed than for reversed lines, and are greatest for lines broadening unsymmetrically towards the red. Mr. Bilham finally directs attention to two lines (3514·14 and 3608·98 approx.) the abnormal behaviour of which under pressure suggest that they are enhanced lines. Two excellent plates accompany the paper, reproducing three portions of the spectrum of nickel under the pressure of one, six, and eleven atmospheres, and the abnormal behaviour of the last two lines mentioned above.

THE BERKELEY ASTRONOMICAL DEPARTMENT.—The results of the researches carried out in the Berkeley Astronomical Department, under the auspices of the University of California, are printed in the established Lick Observatory publications. Vol. vii. of the Publications of the Lick Observatory, recently issued, is devoted completely to a number of researches carried out under the director, Prof. A. O. Leuschner, at the above-mentioned institution. The volume consists of ten sections, some of which have already been issued in separate parts, but others have been delayed in printing owing to lack of funds. The papers are chiefly devoted to methods of determining orbits, the short methods of computation by Prof. A. O. Leuschner being the more extensive. Among the other contributions are the elements of Asteroid 1900 GA by A. O. Leuschner and Adelaide M. Hobe, preliminary elements of comet 1900 III. by R. H. Curtiss and C. G. Dall, tables for the reduction of photographic measures and investigation of the Repsold measuring apparatus by Burt L. Newkirk, and a research on astronomical refraction by Russell T. Crawford.

GEOLOGICAL WORK IN INDIA AND ITS BORDERLANDS.

THE series of publications maintained by the Geological Survey of India allow scope for memoirs on all branches of geology. We may select for mention the following typical papers from recent issues of the Records.

In vol. xli. (1912), p. 266, T. D. La Touche describes the Lonar Lake in Berar, in the Central Provinces, and ascribes its steep-sided basin to the sinking back of a mass of lava which once uplifted the surface as a shallow dome. The rocks round the depression are amygdaloidal lavas; but no sign of crater-formation can be traced. W. Christie (p. 276) reports on the sodium carbonates that give a commercial interest to the lake. He points out that potassium, as usually happens, is retained by the insoluble products of the decomposition of the lavas, so that sodium is the main alkali supplied.

The geological results of the Abor military expedition are stated by J. Coggin Brown (vol. xlii., p. 231), whose notes, although taken during rapid movements in a mountainous country, provide a fairly continuous section up the Dihong river. Limestone boulders with crinoids have been found (p. 240), indicating the northern edge of the Gondwana continent. Both in Canada and Burma we have learnt how such traverses along natural highways may help, when correlated, to explain the structure of wide areas.

The director, H. H. Hayden, discusses (vol. xliii., p. 138) the relationship of the Himalaya to the Indo-Gangetic plain, and emphasises, in the consideration of geodetic results, the low density of the alluvium of the plain and of the Siwalik beds that probably underlie it. He concludes that there is no need to suppose the existence of a huge trough filled with alluvium at the foot of the Himalayan range. While Hayford calculated that the layer of isostatic compensation, where the rocks are subject to equal pressure from all directions, lies in North America at a depth of 122 km., Hayden (pp. 145 and 154) suggests that it may occur in India at a very much greater depth. Where slow earth-movements are still in progress, compensation may not be attained in the layers near the surface of the earth. He concludes (p. 167) that "the geodetic evidence seems to confirm the generally accepted view that the Indo-Gangetic depression is a broad basin, shallow on the outer side and sloping gently inwards towards the Himalaya" at a little more than 2°. The range is separated from it "by a steep wall resulting from the series of reversed faults which separate the older geological systems from the younger." This matter has been discussed by Sir T. H. Holland in his address to the geological section of the British Association in 1914.

J. Coggin Brown publishes a series of contributions to the geology of the province of Yünnan, in Western China, and R. C. Burton describes the volcanic rocks (vols. xliii., pp. 173, 206, and 327, and xliv., 1914, p. 85). In these papers recent changes in the course of the Irrawaddy are mentioned, and the river is said to have been shifted by earth-movements in very recent times into higher country to the west of its former line of flow. The volcanoes of the Têng-yüeh area were active in recent or late Cainozoic times; their cones and craters are preserved, and hot springs still occur. Their disposition and the nature of their products indicate (p. 226) that they are a prolongation of the chain which runs through Java and Sumatra. F. R. Reed adds greatly to the third paper by determinations of the Ordovician and Silurian fossils (these results being termed "provisional" in the text and "provincial" on the cover of the records). An interesting Baltic relationship is pointed out (p. 334). A marked change of conditions occurred in Upper Permian times, when the marine limestones with Fusulina and Schwagerina, which mark the Permo-Carboniferous system, are replaced by terrestrial conglomerates and sandstones, with finally a small marine incursion, giving rise to lagoons and salt-beds (vol. xliv., p. 112).

G. E. Pilgrim contributes a paper of the widest interest on the correlation of the Siwaliks with mammal horizons of Europe (vol. xliii., p. 264). The table forming plate 26 shows the Tertiary river deposits of India, opening with the Gaj Beds as Lower Burdigalian or Upper Aquitanian. The Murree Beds are Burdigalian to Tortonian; the Lower Siwaliks extend from the Tortonian to the top of

the Sarmatian of Europe, and the Middle Siwaliks from the base of the Pontian to what is here taken as Lower Pliocene—that is, Placentian. The Siwalik system ends as "Uppermost Pliocene." The Siwalik system is 14,000 to 16,000 ft. in thickness. Another philosophic paper is by G. De P. Cotter, on the value of Nummulites as zone fossils (vol. xliv., 1914, p. 52). This includes a discussion of Hein's view that nummulites depend a good deal on lithological facies. The author believes (p. 67) that the same uncertainty occurs in dealing with Orbitoides (including Orthophragmina and Lepidocyclina).

Aerolites receive much attention in these recent volumes. G. Cotter describes records in India since 1906 (vol. xlii., p. 265); J. C. Brown deals with the fragments that came from a meteor seen to explode at Banswal, near Dehra Dun, on January 18, 1913 (vol. xliii., p. 237); and W. A. K. Christie describes "A Carbonaceous Aerolite from Rajputana," which fell from a meteor at Chhabra, in Tonk, on January 22, 1911. The carbon of this chondritic mass amounts to 2·7 per cent., and the stone is surpassed in this respect by that of Alais alone. The composition of the carbonaceous matter is not graphitic, and is very uncertain.

Among the papers published separately as Memoirs of the Geological Survey of India we may note Prof. C. Diener's general description of "The Trias of the Himálayas." The author (p. 55) draws the boundary between Permian and Trias below the Otoceras beds in the Himalayas, and between the Bellerophon Limestone and the Lower Werfen beds in the Eastern Alps. In correlating the strata, his survey extends through the Malay Archipelago to the Pacific region. The Mediterranean facies of the Trias is shown (p. 149) not to extend into Afghanistan. "The northern borderland of the Indian Triassic province corresponds to the southern shore of the Angara continent (Suess)" (p. 152).

H. H. Hayden's "Geology of Northern Afghanistan" (vol. xxxix., part 1), contains fine illustrations of the crags and "bad lands" of a typically dry country, dissected by seasonal rains. The highest Carboniferous beds are of the Fusulina Limestone type, and the Cenomanian transgression affects the region. T. H. D. La Touche's memoir on the geology of the northern Shan States of Burma (vol. xxxix., part 2) should be studied in connection with J. Coggin Brown's work on Yünnan, cited above. P. N. Datta was associated with the author in the prolonged field investigations. The ruby mines of Burma occur in this region (pp. 34 and 371), and it is now suggested that the gem-bearing limestone is a band of sedimentary origin. The pisolitic ferruginous clays among the recent deposits (p. 322) are compared with the laterite of India; and the dams of calcareous tufa in the streams, originating in calcium carbonate carried down from limestone plateaus, are of interest for comparison with those of Bosnia and Dalmatia (p. 324). The glacial Talchir beds are traced into the little-known state of Korea in the Central Provinces by L. L. Fermor, in a memoir on the coal-resources of the district (vol. xli., part 2); and J. Coggin Brown reports on the Burma earthquakes of 1912 (vol. xlii., part 1).

The folio memoirs issued under the title of "Palæontologia Indica" are continued by G. E. Pilgrim's report (vol iv., Mem. 2) on the vertebrate fauna of the Gaj series, the stratigraphical results of which are utilised in the author's paper on the Siwalik beds, mentioned above. Prof. A. C. Seward, of Cambridge, describes "Lower Gondwana Plants from Kashmir" (vol. iv., Mem. 3) *Glossopteris indica* prevails, and the author throws doubt on the existence of *G. decipiens* as an independent species. He also deals with "Mesozoic Plants from Afghanistan and Afghan-Turkistan" (vol. iv., Mem. 4), which are beautifully illustrated by T. A. Brock. An interesting map on p. 46 shows, with the aid of a table (p. 45), the wide range of many Mesozoic species or of closely allied forms. *Coniopteris hymenophylloides*, for example, is found in Australia, Arctic Europe, Great Britain, and generally throughout Asia. The highly specialised molluscan fauna of the Spiti Shales is studied by Karl Holdhaus (series xv., vol. iv., part ii., fasc. 4), who concludes (p. 398) that these Jurassic strata probably belong to the upper part of the system.

In the Records of the Mysore Geological Department, vol. xi., issued in 1912, W. F. Smeeth (p. 49) refers the laterites of the State to two series, one modern, produced by the superficial decay of various types of rock, and one older, the "great Mysore sheet," originating in materials precipitated from the waters of lakes, and afterwards laid dry and subjected to laterising conditions. On p. 56 Smeeth urges that the so-called fundamental gneiss of Mysore is intrusive in the Kolar schists, and that "Mysore may be regarded as a house in which the superstructure has been underpinned and a new foundation substituted for the original one." The intrusive nature of the gneisses is further emphasised by P. S. Tyengar and B. Jayaram in vol. xii. of the Records, issued in 1914 (pp. 64 and 77).

J. B. Scrivenor has issued through the Government Printing Office at Kuala Lumpur a paper on the geology and mining industries of Ulu Pahang, in the Malay States, a region traditionally supposed to possess immense mineral wealth. After three years' investigation, the author found but little tin-ore, and he concludes that the old workings for gold were made by persons as economical in their habits as those who carry on the work in the very poor alluvial ground to-day (p. 12). He directs attention (p. 32) to the soils of the andesitic Pahang series as likely to furnish a compensation in agricultural prosperity. The petrographic sections, including radiolarian chert, and the landscape illustrations, reproduced in collotype by Bemrose of Derby, are of remarkable beauty. Another work by J. B. Scrivenor, on the geology and mining industry of the Kinta district, Perak (Kuala Lumpur, 1913; price 3 dollars), is equally well illustrated. The author points out (p. 20) how road-cutting and hydraulic mining have been facilitated by the tropical processes of weathering, whereby the ground-water carries away silica in solution, and "hard, unyielding masses are reduced to the consistency of putty." The most important conclusion in this memoir is that the clays and boulder-clays of Perak, which are mined for the detrital tin-ore which they contain, are not of recent origin. They have been penetrated by the local Mesozoic granite, and rest on the Carboniferous Kinta Limestone. Excellent reasons are given (pp. 38–43) for correlating them with the Permian glacial beds of India. It is remarkable that the tin-bearing and tourmalinised Mesozoic granite must have been preceded in this area (p. 35) by a similarly tin-bearing granite, which formed a contact-aureole, and from which the granite boulders and the cassiterite in the glacial clays have been derived. G. A. J. C.

RAINFALL IN THE PHILIPPINES.

THE Manila Weather Bureau has published a very useful paper on the annual amount and distribution of rainfall over that archipelago, prepared under the direction of the Rev. J. Algué, S.J., by the assistant-director, the Rev. M. S. Masó, S.J. It includes tables showing, *inter alia*, the monthly and annual values for separate years and means for the whole period embraced, which, in most cases, refers

to years since 1902. In an interesting discussion of the data in English and Spanish it is explained that owing to the N.–S. extension of the archipelago and to the main trend of the mountain ranges in the same direction there is much variety in the distribution of the rainfall which is quite opposite in some instances in the eastern and western regions. The latter experience a dry winter and spring and a wet summer and autumn, while in the eastern regions rain is prevalent in autumn and winter. February–April are generally the driest months over the whole archipelago, but as soon as the sun reaches the northern hemisphere thunderstorms and heavy showers become more frequent.

The average yearly rainfall over the whole area is 2400 mm., the extreme values being 900 mm. at Zamboanga (south-west Mindanao), and 4500 mm. at Baguio (west-central Luzon). With some exceptions the average for the northern, eastern, and western coasts exceeds 2000 mm.; it seldom reaches that amount in the valleys, but attains to 2000–3000 mm. in the highlands, and even reaches 4000 mm. in the Baguio plateau at an altitude of 1400 metres. In parts of the east and south-east coasts of Luzon, eastern Samar, and north-east Mindanao, the average is above 3000 mm. There are no large, specially dry regions; whenever a relative failure of rainfall occurs it is generally felt throughout the whole archipelago.

NORTH AMERICAN FROGS AND TOADS.

THE life-histories of North American frogs and toads form the subject of a memoir entitled "North American Anura — Life-histories of the Anura of Ithaca, New York," by Mr. A. H. Wright, just received from the Carnegie Institution of Washington. In the introduction to this highly interesting and well-illustrated work the author acknowledges his indebtedness to Boulenger's "Tailless Batrachians of Europe," published by the Ray Society in 1897–98, which has given the original impetus to and has been taken as the model for his study. The region investigated is at the southern end of Cayaga Lake, and most of the observations were made in the vicinity of Ithaca, New York. The number of Anurous Batrachians included within these limits is small, and only three genera, the widely distributed Bufo, Hyla, and Rana, are represented. The species are the common toad, *Bufo lentiginosus americanus*, the peeper, *Hyla pickeringi*, the tree-toad, *Hyla versicolor*, the leopard- or meadow-frog, *Rana pipiens*, the pickerel-frog, *R. palustris*, the green-frog, *R. clamata*, the bull-frog, *R. catesbiana*, and the wood-frog, *R. silvatica*.

The life-histories of these eight species are very fully described, and are shown to correspond fairly closely with those of their European analogues, on which attention has been bestowed at a much earlier date. Copious notes are given on their first appearance in spring, on their mating, oviposition, and development. Following the example given in the "Tailless Batrachians of Europe," keys are supplied for the identification of the eggs and of the tadpoles. It is to be regretted that the spermatozoa have not been studied. Compared with the European species the tadpole of *R. silvatica* is shown to correspond with that of *R. agilis*, *R. pipiens* and *R. palustris* with *R. arvalis*, *R. clamata* and *R. catesbiana* with *R. esculenta*; *B. americanus* approaches *B. calamita*, and *H. versicolor* *H. aborea*; whilst *H. pickeringi* suggests Bufo in its mouth-parts. Beautiful photographs from life represent specimens in nuptial embrace, the eggs, the tadpoles at various stages of development, males in the act of croaking, etc.

PHYSICS AND ASTRONOMY AT THE BRITISH ASSOCIATION.

THE proceedings of Section A of the British Association in Australia included many interesting papers, and some valuable discussions. The section was fortunate in having a thoroughly representative attendance of English physicists and astronomers, who had made the journey overseas. Amongst those who were present may be mentioned Sir Oliver J. Lodge, Sir Ernest Rutherford, Prof. W. M. Hicks, Prof. A. Gray, Prof. A. W. Porter, Prof. H. H. Turner, the Astronomer Royal, Prof. E. W. Brown, Prof. J. C. Fields, Prof. H. S. Carslaw, Prof. W. E. Cook, and Dr. G. C. Simpson. Dr. C. G. Abbot and Prof. E. Goldstein attended as foreign guests. The local secretaries were Prof. Lyle at Melbourne, and Prof. Pollock at Sydney. The president of the section, Prof. F. T. Trouton, was prevented by illness from making the journey, and his absence was greatly regretted. His duties thus devolved upon the vice-presidents, and Prof. Porter usually acted in his place and bore the brunt of the work. Public interest in the meetings was naturally affected adversely by the outbreak of war, and the attendances at this section were much smaller than has been usual of late years. This was the more unfortunate, because comparatively few papers of a purely specialised and technical character were read, and except on one morning the section was able to meet as a whole.

The meetings opened on Friday, August 14, at Melbourne, with the president's address, which was read by Prof. Porter (see NATURE, August 20, vol. xciii., p. 642). This was followed by the report of the committee to aid the work of establishing a solar observatory in Australia. Prof. Duffield communicated a letter that had been received from the Commonwealth authorities in which it was stated "that in the scheme for the organisation of services in connection with the seat of Government at Canberra, provision has been made for the establishment amongst general astronomical studies of a section to be devoted to solar physics in particular." He also announced that the Premier had consented to receive a deputation from the British Association on the subject. (The deputation, led by Sir Oliver Lodge, waited upon the Premier on the following Tuesday; it was introduced by Mr. Deakin. It was very favourably received, but in the unfortunate circumstances it was felt to be impossible to press for any definite assurances of immediate action.) In this connection a paper on Mount Stromlo Observatory was read by Mr. P. Baracchi, director of Melbourne Observatory. The paper dealt with the suitability of the climatic conditions at Canberra for astronomical work. In 1910 a position was selected about six miles from Canberra, and a small observatory was erected at which observations were made in 1912–13. Evidence was collected which showed that the site was favourable and suitable for the installation of a modern observatory of the first class.

Dr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, read a paper on the variability of the sun. He said that from experiments conducted simultaneously at Mount Wilson, in California, and Bassour, in Algeria, it was found that the intensity of solar radiation (outside the earth's atmosphere) varied through a range of 10 per cent. on different days. The deviations were observed at both stations, so that if, for example, high values were obtained in California, high values were obtained simultaneously in Algeria. The variability is irregular in amount and period, but the range may be as much as 5 per cent. in the course of a week. A connection between the monthly mean values of

the solar radiation and the number of sun-spots was also traced, an increased spottedness of the sun's disc being found to correspond with an increased radiation. It appears, therefore, that the sun, besides varying from day to day, varies also from year to year in accordance with the march of the sun-spot cycle. In addition, observations had been made on the contrast of brightness between the centre of the sun's disc and the limb for different wave-lengths; this also appears to undergo an irregular variation similar to the variation of the total radiation. Further researches on these problems are in progress, including some balloon ascents with self-registering apparatus, in which a height of twenty-two miles has been obtained. Dr. Abbot urged the importance of securing the co-operation of stations widely distributed over the globe to eliminate any local atmospheric influences, and he suggested that work in this branch of solar physics might well be taken up by the proposed new observatory in Australia. A long discussion followed the paper, and, in answer to questions, Dr. Abbot explained the general lines of work which he would like to see carried out in Australia. Dr. Simpson and Mr. Gold discussed the bearing of the results on meteorology. Dr. Abbot showed that a close parallelism existed between the spottedness of the sun and the mean temperature in the United States, the main disturbing factor being the presence of volcanic dust in the atmosphere after some of the great eruptions. These two causes accounted for most of the main features of the temperature curve. Prof. Eddington suggested that a similar irregular variability might be looked for in other stars having spectra resembling the sun's; apparently the amount of variation would be sufficiently great to be detected by differential measures of stellar magnitudes.

The morning's proceedings concluded with a paper by Mr. P. Baracchi on the present state of the determinations of Australian longitudes. The stations at Port Darwin and at Southport (Queensland) are the terminals of two chains of telegraphically determined longitudes, one carried eastward and the other westward from Greenwich. The connection between these two meridians obtained by means of measured longitudinal arcs completes a whole longitude circuit of the globe with a closing error of less than 100 ft.

On Tuesday, August 18, a joint meeting was held with Section B (Chemistry), for a discussion on the structure of atoms and molecules. Sir Oliver Lodge presided. Sir Ernest Rutherford, who opened the discussion, directed attention to the recent accumulation of evidence of the independent existence of the chemical atom. It is no longer merely an hypothesis introduced to explain the laws of chemical combination; we are able to detect and count the individual atoms. We can determine the actual mass of an atom certainly to within a few per cent. The idea that the atom is an electrical structure received a great impetus by the detection of the electron by J. J. Thomson; and, moreover, the Zeeman effect showed that it must be in part electrical. The atomic character of negative electricity is well established; we always find the negative electron, however produced, carrying a definite charge. We have, unfortunately, not the same certainty with regard to the behaviour of positive electricity, for it cannot be obtained except associated with a mass comparable with that of a hydrogen atom. In J. J. Thomson's model of the atom the positive electricity was supposed (for mathematical reasons) to be distributed throughout a large sphere with the negative corpuscles moving inside it. This hypothesis played a useful part in indicating possible lines of advance; but it does not fit in with more recent discoveries, which point to a concentrated positive nucleus. We have now two powerful methods that aid us in determining the inner structure of the atom—the scattering of high-speed particles in transit through matter, and the vibrations of the interior parts of the atom. In C. T. R. Wilson's photographs of the tracks of the α particles through a gas, we notice many sudden bends in the paths; in order to account for these deflections it is found necessary to believe that there is a concentrated nucleus atom (having a certain number of units of charge), in which the main part of the mass resides; outside this there are a number of electrons. The whole dimensions of the nucleus are very small indeed compared with the distance of the outer electrons. From the scattering experiments it appears that the law of force right up to the nucleus is the inverse square law; no other formula would give accordance with the observations. The radius of the nucleus is of the order 10^{-12} cm. in the case of gold, and for a lighter element it is smaller still. Another fact that appears from the scattering experiments is that the number of electrons (outside the nucleus) is about half the atomic weight. There is now fairly good evidence that, if the elements are numbered serially in order of atomic weight, the numbers will actually express the charge on the nucleus. The rate of vibration of the inner parts of the nucleus can now be measured by means of the characteristic X-rays emitted. Each substance has two strong lines in its X-ray spectrum, and as we pass from element to element in order of atomic weight the frequencies of these change by regular jumps. H. G.-J. Moseley has investigated all the known elements in this way, and he is even able to show at what points elements are missing, because at such points the X-ray frequencies make a double jump. In this way he has found that between aluminium and gold only four elements are now missing. It is deduced from these considerations that there is something more fundamental than atomic weight, viz., the charge on the nucleus, and that this is the main factor which controls the frequency of the interior vibrations, the mass having only a slight influence. There are certain elements with identical chemical properties, but different atomic weights; thus radium-B (atomic weight 214) and lead (207) are chemically inseparable and have the same γ-ray spectrum. It is quite clear that some new conception is required to explain how the atoms, having the structure we have supposed, can hold together. N. Bohr has faced the difficulty by bringing in the idea of the quantum. At all events, there is something going on which is inexplicable by the older mechanics.

Prof. Armstrong referred to the new attitude with which the chemical elements were regarded; he had long been prepared to believe that they may eventually prove to be compounds. With regard to the existence of elements of different atomic weights chemically indistinguishable, it is too early to conclude that no method of separation and distinction can be devised. The deduction from the X-ray spectra that very few elements are still missing is scarcely justifiable; it may well be that most of those that are known belong to a *preferred type*, and that this particular series is nearly complete. For the chemist any theory of atomic structure must take fully into account the peculiar valency relationships; the system is admittedly one of extraordinary perfection and simplicity; it should be pointed out, however, that so-called structural formulæ are to be regarded as condensed symbolic expressions of the general behaviour and not as representing the actual structure. Thus the conventional representation of benzene by a plane regular hexagon is quite impossible if the affinities of a carbon atom act tetrahedrally. The variable valency of certain

elements is another difficulty; the variation seems to be determined by some reciprocal relationship between the interacting elements, valency being a dependent variable and not an absolute property. Fresh significance has lately been given to the problems of valency by the conception, due to Barlow and Pope, that it is to be regarded as a function of the volume occupied by the atom. They have in this way succeeded to a remarkable extent in correlating crystalline form with molecular structure.

Prof. Hicks dealt with the subject from the spectroscopic side, *i.e.* from the consideration of an atom as a configuration capable of emitting definite sets of free vibrations. He reviewed the evidence as to the position of helium in the order of the elements. It is assumed by many physicists, including Rutherford, Bohr, and Moseley, that H and He are consecutive elements, having nuclear charges of one and two units respectively. There are several reasons, however, for supposing that there are places for at least two intermediate elements between them; in particular, the theory of Rydberg requires that the atomic number of helium should be 4. In addition to the electrons and positively-charged nuclei, we have to recognise the presence in certain substances of magnetic doublets the strengths of which are multiples of a definite unit, called by Weiss the magneton; whether the magneton has an independent existence or is a consequence of electronic motion is an open question. The formation of spectral series is a very difficult question; neither Thomson's nor Rutherford's model of the atom has shown any aptitude for explaining spectra, and it would seem that the actual structure must be something much more complicated. There is now a general consensus of evidence, theoretical and experimental, that in the case of series the cause of spectral emission is a change in a few atoms (at any one moment) from one configuration to another, with sudden emission of energy. The contrary view, that it is due to small internal vibrations in all the atoms, presents too great difficulties. It does not follow, however, that the whole of the spectral lines are of the character of the series lines, and Nicholson's theory of the coronium and nebulium spectra points to the existence, under the special conditions in the corona and nebulæ, of emission of a different type. Prof. Hicks also reviewed Bohr's theory of spectra, and, whilst admiring its suggestiveness, pointed out the arbitrary character of some of the assumptions, and its limitation to series of the Balmer type.

Mr. H. G.-J. Moseley explained the results of his classification of the elements by their X-ray spectra. The principal frequency ν is given approximately by the formula $\sqrt{\nu} = \text{constant} \times (N - B)$ where B is a constant and N an integer increasing by a unit as we pass from element to element up the periodic table. The order of the elements determined by N is nearly that of increasing atomic weight; there are one or two exceptions, and in such cases the order given by N is evidently the correct order corresponding to chemical properties. For example, the atomic weight gives the order Cl, K, Ar, whereas the X-ray frequency gives the order Cl, Ar, K. The latter is the order required by the periodic table.

Prof. Nicholson defended the main principles of Bohr's theory. Its most striking success is that it gives with great accuracy two fundamental constants —the universal constant of spectra and (as Prof. Fowler has shown) the mass of the electron in terms of the hydrogen atom. But analysis shows that we cannot obtain other spectra from it, *e.g.* the ordinary helium spectrum, without abandoning at least one of Bohr's premises, which is vital to the deduction of the hydrogen formula. Referring to the elements postulated by him in the corona and nebulæ, Prof. Nicholson was prepared to admit that they might not be chemical elements in the ordinary sense; they might rather be the bases of elements. The atomic weights of these elements have been measured by Buisson and Fabry by an ingenious method and agree with those calculated theoretically from the spectra. Nuclear structure (as distinct from the resultant charge) appears to play a considerable part in series spectra, and, in opposition to Rutherford's view, it seems that the nucleus of a hydrogen atom must be something more complex than the positive electron.

Prof. Bassett discussed the bearing of the periodic law on the number of the elements. The periodicity is not of the simple character at first supposed. There are two short periods of 8 elements followed by two long periods of $(2 \times 8) + 2 = 18$ elements. These are followed by much longer periods, possibly of $(2 \times 18) + 2 = 38$ elements. It is tempting to suggest that hydrogen represents a period of 3 elements, because then the short periods would be represented by $(2 \times 3) + 2 = 8$, following the same rule.

Prof. Kerr Grant summarised the difficulty as to the stability of a system consisting of one nucleus and one electron. It was difficult, too, to account for the non-magnetic character of the hydrogen atom with this structure.

The discussion occupied the whole morning, and was followed with keen interest. So many different points of attack on the problem were represented that it could scarcely be expected that any one aspect would be argued out to a conclusion by the different speakers, but, regarded as a symposium, the discussion provided a most useful survey of the present state of our knowledge. A full report is to be printed in the annual volume of the British Association.

The section met again in the afternoon, when Prof. E. Goldstein read a paper on salts coloured by the kathode rays. When the rays fall on certain salts coloration is produced immediately. These colours disappear on prolonged exposure to daylight or when the salt is heated; the rate of disappearance varies greatly for different substances. The characteristic colour and the behaviour on heating afford a means of identifying the substance, and impurities present in very minute quantities can often be discovered in this way, for a very small admixture of the salt suffices. It was at first supposed that the phenomenon was due mainly to a chemical reduction; Giesel and Kreutz obtained analogous colours by exposure of the salts to the vapour of sodium and potassium. But there are important differences between the Giesel colours and those here considered. For example, the former are much more stable when exposed to daylight. Prof. Goldstein showed that stable coloration identical with that obtained by Giesel can indeed be produced by the kathode rays, but as the result of prolonged bombardment in which the salt becomes heated strongly. He calls these "after-colours of the second class" to distinguish them from those of the "first class," which appear immediately on exposure. The colours of the first class depend not only on the metal, but on the acid constituent; indeed, they can be produced in some organic salts which contain no metallic base. There can thus be no question of chemical decomposition; but apparently the matter passes into some changed—possibly polymerised—state which deserves a careful study. Amongst other things the new state is characterised by greatly increased absorption of light. Connected with the loss of coloration by exposure to daylight there is generally a phosphorescence, which follows the exposure. It is possible to produce the same colours by ultra-violet

light, and probably the action of the kathode rays is not direct, but is due to the radiation of ultra-violet light by molecules struck by them. The destruction by the longer waves of daylight of effects produced by the light of short wave-length is a phenomenon of which many other examples occur. The paper was illustrated by specimens of the coloured salts.

Prof. Hicks spoke on the magneton as a scattering agent for α and β particles. The paper dealt with the orbits of charged particles coming into the field of the magneton and the nature of the scattering was explained. Prof. T. R. Lyle gave a demonstration of a mechanical analogue of wireless telegraph circuits.

On Wednesday morning a discussion took place on the problems of Antarctic meteorology. The meeting was fortunate in having the attendance of a number of men of science who were personally familiar with the Antarctic regions. Dr. G. C. Simpson, who opened the discussion, dealt with the main problem of the general circulation of the atmosphere in the southern hemisphere. Dr. Lockyer has suggested that there is an intense anticyclone over the Antarctic continent from which cold air feeds into a ring of large cyclones having their centres about 60° S., and extending northwards as far as 40° S. Prof. Meinardus also has postulated a series of cyclones over the Southern Ocean travelling from west to east; but he finds it difficult to accept anticyclonic conditions over the continent, owing to the great excess of precipitation there which gives rise to the glaciers and snowfields. From a detailed discussion of the conditions in the Ross Sea area Dr. Simpson deduces that the conditions over the continent are anticyclonic. In the lower atmosphere the strong south-easterly blizzards are the result of the large differences of temperature between the barrier and the Ross Sea. In the upper atmosphere the air feeds in again to the Antarctic, as is shown by the cloud observations. Meinardus's objection that in such a circulation the precipitation would not exceed the evaporation is met by a consideration of the great cooling of the air due to radiation. With regard to the existence of a belt of cyclones over the ocean, it appears quite impossible to reconcile wind and barometer observations with any circulation of wind about a low-pressure centre moving from west to east. Further the simultaneous barometer readings at Melbourne, New Zealand, and Cape Adare give no certain indication of the same cyclone affecting the northern and southern stations. Dr. Simpson pointed out an important negative correlation between the pressure at Cape Evans and in Australasia, and urged the importance for Australian meteorology of extensive observations on the Antarctic continent.

Mr. Griffiths Taylor pointed out the importance of the proximity to Australia of this colossal source of cold energy. The Antarctic continent is a much greater land-mass than the Tibetan Plateau; the latter controls the monsoons and has an enormous effect on the Indian climate. Meteorologically the influence of the Antarctic tableland must be a most important fact. Mr. Hunt, Captain Davis, Mr. H. T. Ferrar, Prof. Rudmose Brown, and Mr. Gold also took part briefly in the discussion.

Prof. H. H. Turner then gave an account of the work of the Seismological Committee, referring particularly to the situation of difficulty and anxiety created by the death of Prof. Milne. Progress has been made in the study of the distribution of earthquake centres, and Prof. Turner exhibited a map showing the geometrical relation of these to the land distribution on the globe.

The sitting terminated early, as the members had to leave for Sydney in the afternoon.

The meeting at Sydney opened on Friday, August 21. Sir E. Rutherford spoke first on the origin and nature of the γ rays from radium. Dr. Dyson then read a paper on the stars near the north pole. So far as proper motion is concerned, the area within 9° of the pole is more thoroughly known than any other part of the sky, since the stars down to a faint limit of magnitude, 3700 in number, were observed by Carrington about 1855, and have been re-observed at Greenwich forty-five years later. This region has also been well studied as regards magnitudes, both photographic and visual, the photographic determinations having been made at Greenwich and the visual determinations at Potsdam. From the difference between the photographic and visual magnitudes (called the colour-index) a classification according to spectral type is possible. The proper motions of these stars have been discussed by a statistical method with the view of finding the distribution of the stars in space, particular attention being paid to the differences shown when the stars are grouped according to colour-index. The results which were given by Dr. Dyson are too complex to be summarised here. They bring out in a very striking way the fact that the reddest stars are in the mean at a great distance from us—farther even than the white stars—and that it is the stars in the middle of the spectral series (types F and G) that are closest to the sun. There is good evidence of a considerable diminution in the density of the distribution of the stars between the distances of 100 and 500 parsecs, and the numerical results agree substantially with the diminution found by Kapteyn.

Messrs. Petrie and Chapman gave an account of a curious actinic effect of the juice of *Euphorbia peplus*. The dried juice acts on a sensitive photographic plate in the dark. The effect can be transmitted through black paper impervious to light or through thin aluminium or gold foil. Yet no action on ionised air can be detected with an electrometer. The property is retained after prolonged heating, and a sample dried five years ago is still as active as ever. The juices of many other species of Euphorbia and similar plants have been tested, and have been found to have no comparable action.

Prof. A. Gray read a paper on the attractions of ellipsoidal shells. The principal theorems in the attractions of ellipsoids were deduced by a new and elegant geometrical method.

Papers were also read by Prof. O. U. Vonwiller on the photo-electric effect in selenium, and by Prof. W. G. Duffield on the pressure upon the poles of a carbon arc.

The next meeting was on Monday afternoon, August 24. Prof. Turner gave a paper on discontinuities in meteorological phenomena. The usual methods of harmonic analysis proceed on the assumption that the periodicities looked for persist through the time covered by the observational data. In the case of certain astronomical phenomena, particularly the sunspot cycle, Prof. Turner had arrived at the conclusion that abrupt discontinuities took place from time to time, a change of period taking place at the discontinuity. A simple method was described by which such discontinuities could be detected, and the evidence suitably exhibited. The method was illustrated by applying it to rainfall and other meteorological data for which long records were available. Breaks in the period are found to occur about every seven years. These critical years were determined independently from three separate sets of data, and a good general agreement exists between them.

Prof. Eddington gave an account of a determination of the oblateness of the stellar system. It is well-known that the distribution of the stars is decidedly flattened towards the plane of the Milky Way, and recent counts of stars, made by Chapman and Melotte

at Greenwich, provide a means of making a numerical estimate of the amount of flattening. These statistics extend so far as the seventeenth magnitude, and are directly referred to standard photographic magnitudes. Although magnitude-counts alone are not sufficient to determine the general law of density of distribution of the stars at different distances, yet by comparing the counts in the galactic plane and near the galactic poles the general shape of the surfaces of equal density can be found. The average oblateness is about 1 : 3·5, that is to say, the same falling off in density will be found $3\frac{1}{2}$ times as far away in directions in the galactic plane as at the galactic poles. But the oblateness is not uniform; at greater distances the surfaces of equal density are less flattened; the number given refers to a distance equal to the average distance of stars of about the eleventh magnitude. This value of the oblateness is considerably higher than was anticipated. The Milky Way itself is not included in this estimate, and it probably forms a flat girdle outside the oblate system considered in the paper.

The concluding sitting of the section on Tuesday morning, August 25, attracted a very large attendance, the room being filled to overflowing. Sir Oliver Lodge opened a discussion on radio-telegraphy; he was followed by Mr. Balsillie, Prof. Howe, Dr. Eccles, and others. The meeting was held jointly with Section G (although, owing to their heavy programme, that section was also meeting independently at the same time), and an account of the discussion has appeared in NATURE under the proceedings of the Engineering Section. The large attendance was a tribute to the personality of the opener, but the subject evidently appealed strongly to the general public; from the scientific point of view it was equally satisfactory, and many points of great interest were brought forward.

After the discussion, Prof. Pollock gave an account of some measurements of the wave-length in air of electrical vibrations associated with a thin terminated straight rod.

Mr. Moseley read a paper on high-frequency spectra. The references in the discussion on the structure of the atom to the remarkable results derived from X-ray spectra had aroused much interest; and this fuller account of his researches—postponed from a previous day—was eagerly anticipated. He described the production of the characteristic X-rays of the substance by Kaye's method, and the measurement of their wave-length by reflection of the image of a slit from the surface of a crystal. The elements (from aluminium to gold) were numbered in order with a few gaps left for missing elements; taking this atomic number as ordinate and the square root of the X-ray frequencies as abscissæ, the resulting curves are practically straight lines. In most cases there are two lines in the spectra, and the frequencies of the strong component lie along one straight line in the diagram, those of the weak components along another. It is found (in order to preserve the continuity of the straight lines) that a number must be left vacant for a missing element of the manganese series between molybdenum and ruthenium, and another between tungsten and osmium. These gaps are also indicated by Mendeléeff's table. Much confusion exists in the rare earths as to how many separate elements exist, and the method is able to throw light on this question; there is one element missing between neodymium and samarium. A recent addition to the elements—celtium—is not confirmed by this investigation; the X-ray spectrum indicates that it is a mixture of previously known earths

Prof. Porter read a paper by Mr. Paris and himself on the scattering of light by small and large particles of conducting and non-conducting substances. Suspended particles of sulphur, silver, and copper were used, and the intensity and degree of polarisation of the light scattered in different directions were measured. For the metallic particles, the size could be determined; the diameters in different experiments ranged from 80 to 310 $\mu\mu$. From the direction of maximum polarisation the conductivity of the particles could be measured. It appears that the conductivity diminishes with the size of the particles; and it is suggested that the number of free electrons present in the finely divided metal is smaller than when the material is in mass.

Dr. Rankine described methods of measuring the viscosities of chlorine, bromine, and iodine at a number of different temperatures He discussed the relations between the viscosities of the three gases and showed that they correspond with laws which he had previously found to apply to the inert gases.

During part of this final morning the department of mathematics met separately, Prof. Carslaw presiding. The following papers were read:—Mr. Chaundy, "Symbolic Solution of Linear Partial Differential Equations of the Second Order"; Prof. Fields, "Properties of Algebraic Numbers Analogous to Certain Properties of Algebraic Functions"; Prof. Carslaw, "The Green's Function for the Equation $\Delta^2 u + k^2 u = 0$"; Prof. Hudson, "The Evolute of the Limaçon"; Mr. Macaulay, "The Algebraic Theory of Modular Systems"; Mr. Macaulay, "A Property of Double Points."

Several papers were taken as read during the different sittings. These included a number of local papers, the authors of which were unable to attend. Mr. Herens and Prof. Laby had a paper on an absolute determination of the thermal conductivity of air; Prof. Laby and Mr. Stuart on the nature of γ rays; Prof. Laby and Mr. Adams on the electric resistance of steel tapes; Mr. Hogben, a map of the principal earthquake centres of the south-west Pacific; Mr. Kidson on the general magnetic survey of Australia; Prof. Laby and Mr. Herens on the thermal conductivity of air; Prof. Porter and Mr. Simeon on the change of thermal conductivity during the liquefaction of a metal; Mr. Wellisch on experiments on the active deposit of radium. These papers were all taken as read.

A brief reference must also be made to other activities of the section, outside the ordinary meetings for papers and discussions. To meet the special circumstances of the Australian meeting an extra sitting of the section was arranged at Brisbane, when Prof. E. W. Brown delivered an address on the motion of the moon. Evening discourses and public lectures on physical and astronomical subjects were delivered during the visit by Sir O. Lodge, Sir E. Rutherford, Prof. Turner, Dr. Dyson, and Prof. Eddington. At Sydney the local Astronomical and Mathematical Societies held special meetings which many of the visitors attended and took part in, and in more informal ways the members found much scope for useful activity outside the official programme. A subcommittee, under the chairmanship of Prof. Love, organised a series of experiments to be carried out during the voyage to Australia, and a number of the visiting physicists undertook to utilise the opportunity in this way. No official information as to this work is as yet to hand, but we understand that a good deal was accomplished. Of special interest was Prof. Duffield's investigation of the value of gravity at sea by means of Hecker's apparatus; the experiments were carried out on the outward voyage on the *Ascanius*, the owners (Alfred Holt and Co.) having made very generous provision of facilities for the work.

BOTANY AT THE BRITISH ASSOCIATION.

THE botanical benefits derivable from a visit to Australia began to manifest themselves as soon as we left the shores of England. Taking advantage of the facilities offered by the Blue Funnel Line, it was possible, as a member of the advance party on board the *Ascanius*, to make collections of the plankton daily throughout the voyage from England to Australia, by the Cape.

The writer made qualitative collections with the help of apparatus provided by Prof. Herdman, whose quantitative work went on in spite of the rough weather in the "roaring forties" which laid Dr. Ostenfeld low with a comminuted left patella, to the great regret of all, and especially of the botanists whose invited guest he was. His absence from the field and from the meeting in Australia was felt throughout our visit.

A call at Las Palmas and at Cape Town, of a few hours' duration only, in each case, allowed us to see something of the flora of the Canaries and of Cape Colony respectively. The forests of the silver-leaf tree—*Leucadendron argenteum*—covering the slopes of Table Mountain, were a striking feature in the fine drive of fifty miles on the coast road at the Cape. The time spent in responding, on our first day out, to the S.O.S. signal of the *Gothland*, on the Bishop Rock in the Scilly Isles, could not be made up owing to rough weather east of the Cape, so that we missed the garden-party of 2500 invited by the Governor to meet us at Perth, and we arrived only just in time for the delivery of Prof. Herdman's lecture on "Why We Study the Ocean."

Elaborate preparations had been made to enable us, by train and motor-car, to see something of the types of flora in different parts of West Australia under the able, constant, and ideal guidance of Mr. C. Andrews. Botanists owe him a deep debt of gratitude for placing his thorough knowledge of the flora, as well as his time, so readily at the disposal of the party. Mr. Andrews added to our obligations by writing a well-illustrated article on the flora of West Australia for the Handbook of the State, of which each member received a copy. With such a rich flora (4000 species), of which two-thirds is endemic, a week was tantalisingly little, and we could do little more than note, and collect for subsequent study, specimens of the striking xerophilous, endemic flora made famous by the researches of Robert Brown, J. D. Hooker, Diels, and others. The Proteaceæ, Myrtaceæ, Leguminosæ, and Rutaceæ are orders which stand out by their frequency and ecological adaptations. The flora round King George's Sound at Albany proved a great treat. *Cephalotus follicularis* and *Phylloglossum drummondii* (a club-moss most botanists have never seen living), in plenty, *Boronia megastigma* as abundant as a meadow grass, Xanthorrœa and Kingia in various stages of development, *Macrozamia fraseri*, Eucalyptus of many kinds and limitless in quantity, must suffice to suggest the richness of the botanical features enjoyed.

It was fortunate in one sense that we were, we learnt, six weeks too soon for the blaze of colour and variety of form characteristic of the early summer of West Australia. It is not too much to say that nothing in the whole meeting exceeded the hospitable welcome and generous excursion arrangements made by the Government and people of this State. We returned from the scrub to find the war clouds bursting and to see in Perth a fine illustration of patriotic feeling indicative of the unity of the British Empire.

There was so much of interest on every side that early in our visit it was realised it would be wise to economise our plates by systematising the photographic work of the party. Dr. Holt, the Recorder of chemistry, accordingly suggested a selective distribution of the work, with a subsequent exchange of prints. This idea was extended by the writer to cover the work of the different sections throughout the visit to Australia. A note was inserted in the Journal inviting photographing members to co-operate; and many promised their support.

The botanists were particularly fortunate in finding at all the centres visited preparations made for excursions to districts characteristic of the local flora. To Prof. and Mrs. Osborn we owe a deep debt of gratitude for their help and hospitality at Adelaide. The visits to the mangrove swamp (Avicennia), at the Grange (Henley Beach), to Mt. Lofty Range, and through the Mallee scrub to Mannum, are three excursions not likely to be soon forgotten, made more instructive by the maps and notes prepared by Prof. Osborn.

It was not until we reached Melbourne that the Botanical Section (K) came officially into existence. So far we had been fully occupied in the field. Here, as later at Sydney, it was difficult to find time for the many valuable contributions offered. Miss E. R. Saunders, a vice-president of the section, gave a lecture on a common garden plant, its history and behaviour, illustrated by lantern-slides. This was followed by a well-illustrated account by Dr. C. J. Bond on sex dimorphism in some abnormal begonia flowers. Prof. A. J. Ewart and Miss O. B. Davies described the flora of the Northern Territory, Mr. C. S. Sutton that of Melbourne, while Mr. Hiern contributed a paper on the Australian Ebenaceæ. Contributions were also made by Prof. F. O. Bower, the president of the section ("Modern Derivatives of the Matonioid Ferns"), by Prof. Ewart ("Oxidase Enzymes"), by Miss E. N. Thomas and Miss A. J. Davey ("The Seedling Anatomy of certain Pseudo-Monocotyledons"), Dr. E. N. Berridge ("Casuarina"), Miss Rees ("Fossil Fruits"). Prof. Gunnar Andersson, of Stockholm, suggested a field of work for Australia in his account of the climate in northern temperate and arctic zones during the latest Pleistocene age. Dr. Ostenfeld's paper on the geographical distribution of the sea-grasses, in which he directed attention to the incompleteness of the knowledge of Australian forms, was communicated by Dr. Rendle, who initiated a joint discussion with Section D (Zoology) on the origin of species. This formed one of the most interesting features of the Melbourne meeting, and took place before a crowded audience. A general report will follow.

Prof. Seward's lecture on the fossil plants discovered by Capt. Scott's last expedition in the Antarctic regions aroused much interest. Miss Lorrain Smith described the relationship of fungus and alga in the lichen thallus, and concluded that the relationship is one of nutrition. The fungus is certainly dependent on the alga, but the alga is dependent on the fungus for its nitrogen and partly for its carbohydrates. The botanical excursions at Melbourne proved highly attractive. The outstanding one, for elaborateness of preparation, was that to the National Park, a great national reserve of 150,000 acres, reached by rail, boat, and horseback from Melbourne. To Prof. Ewart and his assistant, Mr. O'Brien, to Mr. Kershaw, curator of the museum, Mr. Catani, and Mr. Audass, botanists owe many thanks for the success of the Melbourne portion of the Australian visit.

The presidential address, already reprinted in NATURE, was reserved for Sydney. This was followed by a series of papers on Eucalyptus, contributed by Messrs. J. H. Maiden, R. T. Baker and H. E. Smith,

R. H. Cambage and Dr. Cuthbert Hall. Time, and Mr. Maiden's too numerous duties as local secretary, prevented adequate discussion of these valuable papers on one of Australia's most variable, abundant, and adaptable genera.

Prof. Seward represented the section in a joint discussion with Sections C, D, and E on the past and present relations of Antarctica. A verbatim report of this debate was authorised by the council.

Prof. Margaret Benson spoke on recent advances in our knowledge of Sigillaria. Papers were also contributed by Prof. T. G. B. Osborn on types of vegetation on the coast in the neighbourhood of Adelaide, and on the life-history of *Ophiobolus graminis*, by Mr. A. G. Hamilton, a well-known local botanist, on the xerophytic characters of *Bossiaea scolopendria*.

Dr. J. B. Cleland described certain features in the spores of Basidiomycetes. Mr. F. Turner illustrated his botanical survey of New South Wales by many specimens, as did Mr. R. P. Gregory in the account of his investigations on inheritance in certain giant races of *Primula sinensis*. A long motor drive through fine scenery to Bulli, the source of Sydney's water supply, under Mr. Maiden's guidance, proved a charming addition to our excursion experiences. Field excursions in plenty, systematic botany contributions, especially by botanists working in Australia, valuable Mendelian contributions in this Mendelian year, seem to be the outstanding features of the Botanical Society's activities in Australia. Some of us had the good fortune to visit Brisbane, Townsville, Cairns, Port Darwin, Java, Peradeniya, and Singapore, in nearly all of which not only was the local flora seen, but also the botanical gardens were visited. To Mr. F. M. Bailey, the Government botanist of Queensland, and his family, to Mr. Shirley, and to Mr. Burkill, of Singapore, we owe thanks for many kind attentions. At all "call" places on our way home we were welcomed, entertained, and shown features of botanical interest, making it not a little difficult to settle down once more to normal life. T. J.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—Dr. W. Ramsden, senior demonstrator in physiology, University of Oxford, has been elected to the Johnston chair of biochemistry in the University rendered vacant by the resignation of Dr. Benjamin Moore.

LONDON.—The resignation of Prof. F. T. Trouton, F.R.S., from the professorship of physics at University College has been accepted by the Senate.

More than 1000 applications for commissions in the Army have been forwarded to the War Office from cadets and ex-cadets of the University contingent of the Officers Training Corps, and other students and graduates since the outbreak of war.

Sir Alfred Pearce Gould is acting as Vice-Chancellor during Sir Wilmot Herringham's absence at the front.

THE Rev. Dr. J. P. Mahaffy has been appointed Provost of Trinity College, Dublin, in succession to the late Dr. Traill.

IT is stated in *Science* that Mr. W. K. Vanderbilt has given 27,150*l.* toward the purchase by Columbia University of a half block of land adjoining other land owned by the university; and that the University of Pennsylvania receives 10,000*l.* by the will of the late Miss Anna Blanchard, of Philadelphia.

THE Department of Agriculture and Technical Instruction for Ireland is offering for competition in 1915 among students of science and technology a limited number of scholarships and teacherships-in-training tenable at the Royal College of Science, Dublin. The scholarships are of the value of 50*l.* per annum, and, in addition, entitle the holder to free instruction during the Associate course, and third-class railway fare for one journey each session to and from Dublin. A teachership-in-training entitles the holder to free instruction during the Associate course, a maintenance allowance of 21*s.* per week for the session of about forty weeks each year, and third-class railway fare for one journey each session to and from Dublin. Candidates must have been born in Ireland, or have been resident in Ireland for three years immediately prior to June 1, 1915. They have to satisfy the Department as to their knowledge of English and of one other language. Applications for admission to the examination must be made not later than April 29, 1915, on Form S. 34, copies of which may be obtained upon application to the Secretary, Department of Agriculture and Technical Instruction for Ireland, Upper Merrion Street, Dublin, or to the Registrar, Royal College of Science, Upper Merrion Street, Dublin.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1913–14 has now been published. At the recent examinations, 23,119 candidates were presented in technology from 467 centres in the United Kingdom, and of these 14,570 passed. These figures show an increase of 1241 in the number of examinees, and of 952 in the number of those who passed. By including 753 candidates from India, from the overseas Dominions, and from other parts of the British Empire, 998 candidates for the special examination in magnetism and electricity, held by arrangement with the Postmaster-General, 67 for special examinations in cookery and needlework, and 1839 for teachers' certificates in manual training and domestic subjects, the total number examined was 26,776. The report states there can be no doubt that the teaching of technology has improved greatly during the past few years; but it is noted that the examiners have still to direct attention to the insufficient knowledge that some candidates possess of the principles of their subjects, and to the lack of practical knowledge shown by others, and they think the unsatisfactory answers in consecutively numbered papers which have been found to be the work of students of the same class indicate faulty teaching as the source. The purpose of technical instruction being the better training of the artisan to understand and appreciate the scientific principles that underlie his trade or craft, the attention of teachers should especially be directed to the necessity for a more thorough training of students in fundamental principles. The inability of candidates to express themselves clearly is perhaps not so noticeable as in past years, but the examiners have again to point out the difficulty that simple mathematical calculations present to many candidates—a defect which can only be attributed to insufficient preliminary training.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 12.—Sir William Crookes, president, in the chair.—W. L. **Balls** and F. S. **Holton**: Analyses of agricultural yield. Part I.—Spacing experiments with Egyptian cotton. The aim of the experiments is the statistical analysis of the yield of agricultural crops, in terms of plant development, by careful recording of all stages. The effects of environmental conditions on crop development can then be

satisfactorily analysed. The effects of varying spacing, date of sowing, and season, upon Egyptian cotton, have been subjected in this way to critical examination by the authors. A secondary aim has been to appreciate the reasons for conventional agricultural practice. For each of twenty different spacings, the numbers of flowers daily, and of fruits, together with the weights of cotton and seed per fruit, have been recorded. The extent to which each of these components enters into the building up of the final yield is shown. The dense planting conventionally practised by the Egyptian fellah is shown to give the maximum possible yield per unit area under the limitations of field cultivation, though the normal extension of the root-system of an isolated plant can utilise more than ten times the soil-surface allotted to it in field-crop. Most of the phenomena of field-crop physiology in the fruiting season are thus shown to be traceable to root-interference.—J. **McIntosh** and P. **Fildes**: The fixation of arsenic by the brain after intravenous injections of salvarsan. After intravenous injections of salvarsan and neosalvarsan in man and animals no arsenic can be found in the brain. This phenomenon is not due to lack of affinity between the brain and the drugs, but to an inability on the part of the drugs to penetrate into the substance of the brain. Fixation of arsenic by the brain occurs as readily as by the liver, as shown by experiments *in vitro* and the toxic effects of intrathecal injections. Penetration of neosalvarsan into the brain cannot be obtained even by frequently repeated intravenous injections.—A. E. **Everest**: The production of anthocyanins and anthocyanidins. Part II. The author brings forward further evidence to support the conclusions arrived at by him in his previous paper (Roy. Soc. Proc., B, 1914, vol. lxxxvii., p. 144), namely, that the red, blue, and violet flower and fruit pigments (anthocyans) may be produced by reduction of flavone and flavonol derivatives in acid solution. Experiments are described which show that pure disaccharides of the flavonol series pass without hydrolysis to anthocyanins. The flavone and flavonol pigments having been previously synthesised by Kostanecki, the processes described by the author complete the synthesis of the anthocyan pigments.—H. M. **Woodcock** and G. **Lapage**: Living observations on the life-cycle of a new flagellate—*Helkesimastix faecicola*—together with remarks on the question of syngamy in the trypanosomes. *H. faecicola*, ng., n.sp., occurs in goat-dung and sheep-dung; it is a "passenger," being carried through the alimentary canal in an encysted state. The authors have cultivated this flagellate in various media. They have observed the entire course of the life-cycle in life, from excystation to encystment.—S. W. **Patterson**: The antagonistic action of carbon dioxide and adrenalin on the heart. Carbon dioxide alone depresses all the functions of the isolated heart. Adrenalin, besides dilating the coronary vessels, has a specific action in increasing the rate and strength of ventricular contraction. The effect of carbon dioxide and adrenalin combined is still to allow of more rapid and stronger contraction and rapid relaxation, and also to lengthen the diastolic period. Thus, greater filling of the heart takes place, and the heart is in a better condition for putting out a maximal output.

Zoological Society, November 10.—Prof. E. W. MacBride, vice-president, in the chair.—R. I. **Pocock**: Some unrecorded structural differences between the pine-marten (*Martes martes*) and the beech-marten (*Martes foina*). The two species, apart from the known differences in the skull and teeth, may be distinguished by the size of the ears, which are broader and longer in *M. martes* than in *M. foina*, and by the dimensions of the pads on the feet, which are considerably larger and less overgrown with hair in *M. foina* than in *M. martes*.—Dr. F. E. **Beddard**: Anatomy and systematic arrangement of the Cestoidea. A new genus and species of the family Acoleidæ was described, based upon a large number of examples obtained from the Canadian tree-porcupine (*Erethizon dorsatum*.—H. R. **Hogg**: Report on the spiders collected by the Wollaston and British Ornithological Union Expeditions in Dutch New Guinea. This collection confirms a good deal of the work of previous authors, and at the same time brings to light much that is new. Leaving out the Attidæ, there are representatives of nine families, comprising twenty-six genera (of which one is new) and forty-five species or subspecies of which some nineteen are new.

Physical Society, November 13.—Dr. A. Russell, vice-president, in the chair.—D. **Owen**: A bridge for the measurement of self-induction. An alternate-current bridge method is proposed for the determination of self-induction in terms of capacity and resistance. The inductance L is given by the relation $L=K_3r_1R$; in addition to which it is also necessary for balance of the bridge to satisfy the condition $K_3r_1=K_4r_2$. The conditions of balance may be secured without mutual interference. The end point is rapidly attained. The possibility of effecting a balance is unlimited by the value of the unknown L. The method is independent of frequency, and it is unnecessary to employ a pure sine voltage. Good results may be attained with a buzzer as source and a telephone receiver as detector. The dependence of sensibility of the bridge on the frequency is discussed, and over a wide range the sensibility is high. The effects of residual inductance in the resistance coils and leads, and of absorption in the condensers, may be allowed for, the formula then becoming $L=K_3r_1(R-R_0)$. Tests are quoted showing that with the same pair of condensers measurements over the full range from one microhenry upwards may be made. For inductances of the order of 10 microhenries the error may be kept within a few parts in 1000; whilst if the inductance is as high as a few millihenries the error of any measurement may be reduced below one part in 10,000. The application of this bridge to the determination of capacity in terms of self-inductance is discussed, and an example is given of a test of the temperature variation of capacity of a standard mica condenser over the range 0°–30° C.—B. W. **Clack**: The coefficient of diffusion in dilute solutions. Modifications have been made in the apparatus previously described to determine the value of the coefficient of diffusion of salts through water, by means of which the steady state is hastened and results obtained more quickly. The single wide tube previously employed is replaced by a battery of shorter and narrower tubes. The error due to end-correction is investigated and results are given for the salts KCl, KNO_3, and NaCl for various concentrations down to very dilute solutions.

Royal Meteorological Society, November 18.—Dr. H. N. Dickson, vice-president, in the chair.—Dr. H. R. **Mill** and C. **Salter**: Isomeric rainfall maps of the British Isles. The average monthly rainfall expressed as a percentage of the average annual fall of each of about 300 stations forms the basis of a set of twelve monthly and four seasonal maps. The most striking features are the occurrence of two types of seasonal march; one chiefly characteristic of western or wet districts, having a winter maximum and a summer minimum, the other chiefly confined to eastern or dry districts, having a winter minimum, and a summer or autumn maximum. The equinoctial maps show the transitional stages between these two extremes, the spring months having everywhere a low rainfall

and small range with a central maximum inland and a peripheral minimum on the coast, and the autumn months a large rainfall with a central minimum and a peripheral maximum. The maps show that the relation of heavy rainfall with high-lying land is a relation of cause and effect, the relation of the winter maximum with the heavy rainfall is therefore an indication of a common cause. High land is only associated with heavy rain because it meets rain-bearing winds, and the true connecting circumstances are the position of high land and its relation to the prevailing winds. The occurrence of rain with easterly winds, affecting principally the east coast, makes it impossible to view the British Isles as having a rainfall *régime* solely produced by south-westerly winds. The far greater frequency of southerly and westerly winds than of easterly and northerly, and the fact that the latter occur mainly at certain seasons, go far to explain the features both of the average rainfall maps and of the isomeric maps.—J. I. **Craig**: A see-saw of temperature between England and Egypt. Diagrams were given of lines of thermal equi-correlation with Egypt.

PARIS.

Academy of Sciences, November 9.—M. P. Appell in the chair.—Emile **Picard**: Concerning the hydrodynamical paradox of d'Alembert. Remarks on a recent note by M. Pierre Duhem.—Pierre **Duhem**: Remark on the hydrodynamical paradox of d'Alembert.—A. **Laveran**: Remarks on the prophylaxy of typhus in armies in the field. That the infection of typhus is carried by lice has been proved by Nicolle at Tunis, and confirmed by American physicians in Mexico. Under the conditions necessitated by fighting in trenches the chance of an epidemic is greatly increased. Special importance, therefore, attaches to personal cleanliness in the troops at the front.—M. **Balland**: The preservation of food for army service. A method has been proposed according to which meat, rice, and agar-agar are sealed in a tin, the cooking being carried out after sealing the tin. It is pointed out that the official method in the French Army, in which the meat is cooked before canning, gives a more concentrated product, and the addition of rice and agar-agar is deprecated.—A. **Brachet**: The action of butyric acid upon the development of the eggs of the sea-urchin.—H. **Bourget**: Observations of the transit of mercury across the sun made at the Observatory of Marseilles. Observations of the contact times were carried out under good atmospheric conditions.—D. **Eginitis**: Observations of Delavan's comet made at the Athens Observatory with the Doridis equatorial (Gautier, 40 cm.). Positions given for September 18, 19, and 30, and October 1. The comet was visible to the naked eye, with a tail of 5°, and of apparent magnitude 5.—B. **Globa-Mikhailenco**: Equilibrium figures of a fluid mass in rotation, infinitely near an elliptical cylinder.—A. **Mesnager**: A rapid method for the calculation of arches. A diagram is given for the rapid graphical determination of the bending moment.—Charles **Rabut**: The Eauplet bridge and the deformation of arcs.—M. **Amans**: The problem of flight.—F. **Garrigou**: A simple method of obtaining the notion of relief in radioscopy.—Louis **Gentil**: The structure of the plateau of Oulmès, Central Morocco.—Charles **Nicolle**, G. **Blanc**, and E. **Conseil**: Some points in the experimental study of exanthematic typhus. The lice do not transmit the disease before the eighth day after infection; they transmit it on the ninth and tenth day after infection. This was also found to be the case with the excreta of lice nourished on infected blood. Experiments on hereditary infection in lice gave negative results in all cases.—MM. **Caillaud** and **Corniglion**: Contribution to the study of the treatment of tetanus. The treatment adopted for two cases was a daily intra-muscular injection of 1 per cent. solution of carbolic acid, either alone, or in conjunction with (for two graver cases) intra-venous injection of lantol or colloidal rhodium. All four cases were cured, although two other cases treated with anti-tetanic serum and chloral died after three days. In the four patients cured the definite symptoms of tetanus were well developed before the treatment was started. The same method has also been successfully applied to five cases of tetanus at Cannes. In all there have been nine cures in nine cases.—Aug. **Lameere**: The male of Dicyema.

BOOKS RECEIVED.

Proceedings of the Edinburgh Mathematical Society. Vol. xxxii. Session 1913–14. Pp. viii+168. (Edinburgh: Mathematical Society.) 7*s.* 6*d.*

Manchester Astronomical Society. Journal of the Session 1913–14. No. 1. Pp. x+43. (Manchester: Astronomical Society.) 2*s.*

A Geography of Australasia. By G. Taylor. Pp. 176. (Oxford: Clarendon Press.) 1*s.* 6*d.*

The Indian Museum, 1814–1914. Pp. xi+136+lxxxvii. (Calcutta: Indian Museum.)

The Psychological Researches of James McKeen Cattell. A Review by some of his Pupils. (Archives of Psychology, No. 30. April.) Pp. v+101. (New York: The Science Press.)

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. lviii. Nov. Part i. (Glasgow: Institution of Engineers and Shipbuilders.)

The Master-Key: a New Philosophy. By D. Blair. Pp. vi+118. (Wimbledon: Ashrama Agency.) 3*s.* 6*d.* net.

Bulletin No. 12. The Indian Association for the Cultivation of Science: Iron in Ancient India. By Prof. P. Neogi. Pp. x+78. (Calcutta: Indian Association for the Cultivation of Science.) 3*s.* net.

Canada. Department of Mines. Geological Survey Branch. Memoir No. 20 E.: Gold Fields of Nova Scotia. By W. Malcolm. Pp. xvi+331+Maps. Memoir 42: The Double-Curve Motive in North-eastern Algonkian Art. By F. G. Speck. Pp. 17+Figs. 25+Plates xviii. (Ottawa: Government Printing Bureau.)

University of Bristol. Calendar, 1914–15. Pp. 324. (Bristol: The University.)

Stability and Equilibrium of Floating Bodies. By B. C. Laws. Pp. ix+251. (London: Constable and Co., Ltd.) 10*s.* 6*d.* net.

A Manual of Weeds. By A. E. Georgia Pp. xi+593. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

Food Products. By Prof. H. C. Sherman. Pp. ix+594. (London: Macmillan and Co., Ltd.) 10*s.* net.

History of Upper Assam, Upper Burmah, and North-Eastern Frontier. By Col. L. W. Shakespear. Pp. xvii+272. (London: Macmillan and Co., Ltd.) 10*s.* net.

Transpiration and the Ascent of Sap in Plants. By Prof. H. H. Dixon. Pp viii+216. (London: Macmillan and Co., Ltd.) 5*s.* net.

The Mirror of Perception. By L. Hall. Pp. 129. (London: Love and Malcomson, Ltd.) 2*s.* 6*d.*

British Museum (Natural History). British Antarctic (*Terra Nova*) Expeditions, 1910. Natural History Report. Geology. Vol. i. No. 1: Antarctic Fossil Plants. By Prof. A. C. Seward. Pp. 49+viii Plates. (London: British Museum (Natural History); Longmans and Co.) 6*s*.

The Botany of Iceland. Edited by Drs. L. K. Rosenvinge and E. Warming. Part I. 2. An Account of the Physical Geography of Iceland, with special reference to Plant Life. By Prof. T. Thoroddsen. Pp. 191—343. (Copenhagen: J. Frimodt; London: J. Wheldon and Co.)

A Text-Book of Inorganic Chemistry. Edited by Dr. J. N. Friend. Vol. i., Part i.: an Introduction to Modern Inorganic Chemistry. By Dr. J. N. Friend, H. F. V. Little, and Dr. W. E. S. Turner; Part 2: The Inert Gases. By H. V. A. Briscoe. Pp. xv+385. (London: C. Griffin and Co., Ltd.) 10*s*. 6*d*. net.

A Theory of Time and Space. By A. A. Robb. Pp. vi+373. (Cambridge University Press.) 10*s*. 6*d*. net.

The House-Fly, *Musca domestica*, Linn. By Dr. C. G. Hewitt. Pp. xv+382. (Cambridge University Press.) 15*s*. net.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1913. Pp. 110. (Bath: *Herald* Press.)

Elements of Geometry. By S. Barnard and J. M. Child. Parts i.–vi. Pp. ix+465+xxxviii+Answers. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

The Principles of Irrigation Practice. By Dr. J. A. Widtsoe. Pp. xxvi+496. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Japan To-day and To-morrow. By H. W. Mabie. Pp. ix+291. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Feeble-Mindedness: its Causes and Consequences. By Dr. H. H. Goddard. Pp. xii+599. (London: Macmillan and Co., Ltd.) 17*s*. net.

Lektrick Lighting Connections, with Introductory and Explanatory Notes. By W. P. Maycock. Third edition. Pp. 133. (London: Lundberg and Sons.) 6*d*. net.

Transactions and Proceedings of the New Zealand Institute for the Year 1913. Vol. xlvi. June, 1914. Pp. vii+436. (Wellington, N.Z.: J. Mackay; London: W. Wesley and Son.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 26.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Power Plant Testing: W. M. Selvey.

FRIDAY, NOVEMBER 27.

PHYSICAL SOCIETY, at 5.—Note on the Conduction of Electricity at Point Contacts: A. F. Hallimond.—Thermal Conductivity of Badly Conducting Solids: T. Barratt.

SATURDAY, NOVEMBER 28.

ESSEX FIELD CLUB (at the Essex Museum, Stratford), at 6.—Illustrations of Mycetozoa, dedicated to Samuel Dale, M.D., in Mecheli's "Nova Plantarum Genera," 1729: Miss G. Lister.—Note on Leaf-rolling Caterpillars: E. Linder.

MONDAY, NOVEMBER 30.

ROYAL SOCIETY OF ARTS, at 8.—The History and Practice of the Art of Printing: R. A. Peddie.

ARISTOTELIAN SOCIETY, at 8.—Inaugural Address: Science and Philosophy: Dr. B. Bosanquet.

INSTITUTE OF ACTUARIES, at 5.—Inaugural Address by the President, Mr. E. Woods.

TUESDAY, DECEMBER 1.

ILLUMINATING ENGINEERING SOCIETY at 8.—Illuminating Engineering in War Time: Some Lessons to be Learned from the Present Lighting of London: Dr. Leon Gaster.

WEDNESDAY, DECEMBER 2.

ROYAL SOCIETY OF ARTS at 8.—Britain and Germany in Relation to the Chemical Trade: Dr. W. R. Ormandy.

ENTOMOLOGICAL SOCIETY, at 8.—The Structure of the Scent-organs of Certain Butterflies: Dr. H. Eltringham.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Application of Spectography to Analysis: Dr. S. J. Lewis.—Note on Some Oleaginous Seeds: F. R. Bolton and E. M. Jesson.—Corrections in Bomb Calorimetry: G. N. Huntly.—Note on the Determination of Sulphates in Flour: G. D. Elsdon.

GEOLOGICAL SOCIETY, at 8.—The Shippea Hill Man: Prof. T. McKenny Hughes.—A Bone Implement from Piltdown (Sussex): C. Dawson and Dr. A. Smith Woodward.

THURSDAY, DECEMBER 3.

ROYAL SOCIETY, at 4.30.—*Probable Paper*: The Thermophone: A New Form of Telephone: M. de Lange.

CHILD STUDY SOCIETY, at 7.30.—Self Expression through Language with Older Children: Margaret Corner.

FRIDAY, DECEMBER 4.

GEOLOGISTS' ASSOCIATION, at 8.

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